Government Guarantees and Bank Vulnerability during a Crisis: Evidence from an Emerging Market

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Abstract

We analyze the performance of Indian banks during 2007–09 to study the impact of government guarantees on bank performance during a crisis. Vulnerable private-sector banks performed worse than safer private-sector banks; however, the opposite was true for state-owned banks. Exploiting geographic variation in exposure to public sector bank branches, we show that vulnerable private-sector bank branches in districts with greater exposure to public sector bank branches experienced deposit withdrawals and shortening of deposit maturity. In contrast, nearby vulnerable state-owned bank branches grew their deposit base and increased loan advances but with poorer ex-post performance. Our evidence suggests that lack of market discipline — in the form of access to stronger government guarantees and forbearance during an aggregate crisis — allows state-owned banks to access and extend credit cheaply despite their under-performance.

JEL: G0, G2, H1

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1. Introduction

Motivation

The issue of state versus private ownership has been widely debated in the law and finance literature. Early economists such as Lewis (1949), Meade (1948) and Allais (1947) favored state

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ownership to correct for market imperfections [see Shleifer (1998) for an overview]. For banks in particular, Gerschenkron (1962) and Stiglitz (1989) argue that state-ownership of banks may be necessary for economic development since the lack of economic infrastructure may make it difficult for privately owned commercial banks to attract sufficient capital to succeed. In this view of the world, state ownership is socially optimal. An opposing strand of literature highlights the negative effects of state ownership of banks. This literature can be broadly classified into (i) the political view, and (ii) the agency view. The political view argues that it is the political influence of state-owned banks and not the social objective that drives banking decisions [Shleifer and Vishny (1994)]. The agency view, on the other hand, argues that it is the agency problem arising from the poor provision of incentives in state-owned banks that gives rise to increased corruption and lazy banking [Bannerjee (1997), Banerjee et al. (2005)] resulting in misallocation of resources [Qian and Yeung (2015)] and lower overall growth [Barth et al. (2001) and Dinç (2005)].

In this paper, we highlight another channel —*the lack of market discipline* — through which state ownership can distort the banking system. In particular, as state-owned banks have a sovereign guarantee, creditors prefer state-owned banks relative to private sector banks in spite of the state-owned banks' greater risks. This, in turn can result in reduced market discipline on state owned banks. India, which has a mix of state-owned banks or public sector banks (PSBs)[2] and private sector banks, provides an ideal setting to explore the question of how state ownership can distort market discipline. While state-owned banks in India are explicitly and implicitly guaranteed by the government, private sector banks are not (or arguably, are guaranteed to a much weaker extent). While the previous law and finance literature has focused on the diversion of funds due to political motives, our paper is the first to emphasize that the lack of market discipline on state-owned banks can result in distortions in the banking system which manifest themselves particularly during crisis periods.

[2]PSB is an acronym commonly used to refer to state-owned or public sector banks in India. Accordingly, PSB refers to public sector banks henceforth.

In particular, we examine the impact of government guarantees on banks in India around the global financial crisis of 2007–09. We look at *ex-ante* heterogeneity in bank vulnerability to a market-wide shock for the period preceding the crisis (January 2007 to December 2007). Then, separately for private sector banks and PSBs, we analyze around the financial crisis in 2008–09 the relationship between ex-ante bank vulnerability and (i) realized stock returns; (ii) deposit flows and corresponding deposit rates; (iii) loan advances and corresponding loans rates; and, finally, (iv) loan performance.

Empirical Strategy and results

As a first step to determine the role played by government guarantees, we relate ex-ante measures of bank vulnerability to the stock performance during the crisis. Our bank vulnerability measure, Marginal Expected Shortfall (*MES*) — proposed by Acharya et al. (2017b) — captures the tail dependence of the stock return of a financial firm on the downside of the market as a whole. It estimates the negative of the average stock return for a given financial firm in the worst 5 percent days of the market index for a particular past period (one year preceding a crisis in our case). The greater the *MES*, the more vulnerable is the firm to aggregate downturns. We focus on two event dates, the Bear Stearns collapse on 17^{th} March 2008 and the Lehman Brothers bankruptcy on 15^{th} September 2008. Figure 1, shows that the relative difference in the stock market index between high and low *MES* PSBs started increasing after the Bear Stearns collapse whereas the relative difference in stock market returns between high *MES* and low *MES* private sector banks fell drastically. This pattern became more pronounced following the Lehman Brothers bankruptcy. An event study analysis using market-weighted cumulative abnormal returns (CAR) around the two event dates shows similar patterns. Finally, we relate *MES* to the realized stock returns separately for private and public sector banks for the entire crisis period defined as the period from January 2008 to February 2009. Consistent with the above analysis, we find that a 1 pp higher *MES* is associated with a 6.61 pp decline in realized stock market returns for private sector banks whereas a 1 pp higher *MES* is associated with a 6.12 pp increase in realized stock market returns of public

sector banks.

We show that this heterogeneity in stock performance can be explained by a flight to quality of deposits from private to public sector banks during the crisis period. Overall, private sector banks experienced a deposit contraction from 22.3 percent to 9 percent during the crisis. In contrast, PSBs managed to grow their deposits by 26.9 percent. Univariate analysis relating MES to the annual deposit growth from March 31st 2008 to March 31st 2009[3] shows that deposit growth of more vulnerable private sector banks declined whereas the deposit growth of more vulnerable public sector banks *increased* during the crisis. A 1 pp higher MES is associated with a 9.07 pp decline in deposit growth of private sector banks whereas a 1 pp higher MES is associated with a 1.14 pp increase in deposit growth of public sector banks. However, simply examining the cross-sectional heterogeneity of deposit growth across MES may be confounded. The main identification challenge is that deposit supply may be responding to contemporaneous changes in the banks' lending opportunities rather than a flight-to-quality during the crisis period. For example, if the more vulnerable private sector banks also witness a decline in lending opportunities during the crisis period, then we would see high MES private sector banks make fewer loans and as a result they would take in fewer deposits.

To address this identification challenge, we use a within-bank analysis and exploit geographic variation in exposure of private sector bank branches to public sector bank branches in the local deposit markets (districts). The intuition is that simply comparing deposits across banks may be confounded by differences in banks' lending opportunities. By comparing deposit flows across branches of the same bank located in areas with different exposure to public sector bank branches, we are controlling for these differences in lending opportunities. The identifying assumption for the within-bank estimation is that banks can raise deposits at one branch and lend them at another and thus local market (district) deposit flows are not affected by differences in lending

[3]Only annual data is available for the fiscal year ending March. We use data starting March 2008 to March 2009 because this covers the two crisis events in our analysis.

opportunities of banks.[4] Our analysis shows that more vulnerable (high MES) private sector bank branches with high exposure to PSB branches, saw a fall in deposit growth by 4.49 pp relative to other branches of the same private sector bank with lower PSB exposure. In contrast, more vulnerable public sector branches in these districts witnessed a relative *increase* in deposits of 3.8 pp.

We hypothesize that these cross-sectional differences in deposit growth can be attributed to (i) the presence of explicit and implicit government guarantees for PSBs which led to a flight of deposits from private sector banks to PSBs during the crisis, and (ii) more vulnerable PSBs increasing deposit rates during the crisis in order to attract the deposit flows from private sector banks. Both these ingredients are needed to explain the cross-sectional heterogeneity in deposit growth of PSBs. We explain the reasoning below.

First, the presence of government guarantees resulted in a flight-to-quality from private sector banks to PSBs.[5] The Bank Nationalization Act explicitly places all liability for PSBs on the government. These guarantees for PSBs can also be implicit. For example, as the crisis of 2007–09 progressed the Indian government announced a number of wide-ranging stimulus plans to jumpstart the banking system. PSBs were promised capital injections to help them maintain a risk-adjusted capital ratio of 12 percent. The government also launched three fiscal stimulus packages during December 2008–February 2009. Importantly, in the second stimulus package the government recapitalized state-run banks and infused nearly Rs. 31 billion (approximately $0.5 billion) in 2008-09 as tier-I capital.[6] Additionally, although deposits of both public and private

[4]Drechsler et al. (2018) and Cole (2009a) use similar geographic variation for identification.

[5]Anecdotal evidence supports this hypothesis. Following the credit crisis and the subsequent fall of Lehman, many depositors shifted deposits out of private and foreign banks and moved it to government banks. For example, Infosys (a large Indian multinational corporation) transferred nearly Rs.10 billion of deposits from ICICI to SBI just after Lehman's collapse in the third quarter of 2008 ("Deposits with SBI zoom past Lehman collapse", April 7, 2009. http://articles.economictimes.indiatimes.com2009-04-07news27639025_1_private-banks-bank-deposits-deposit-base). Private sector banks too blamed this flight of funds from private to public sector banks on sovereign guarantee of the PSBs ("Pvt banks want deposit insurance cap hiked", Business Line, January 17, 2009. http://www.thehindubusinessline.inbline20090117stories2009011751460600.html).

[6]See "India - First Banking Sector Support Loan Project", June 26, 2009. (http://documents.worldbank.org/curated/en/2009/06/10746593/india-first-banking-sector-support-loan-project.)

sector banks are insured by the Deposit Insurance and Credit Guarantee Corporation (DICGC), government guarantees of PSBs still matter since deposit insurance coverage is limited and only partially effective.[7]

The presence of government guarantees, however, can *only* explain a flight-to-quality from private-sector banks to PSBs. To explain the cross-sectional result that *more* vulnerable PSBs managed to attract the deposit outflow from the private-sector banks, we show that vulnerable PSBs were also increasing their deposit rates.[8] Relative to the more vulnerable PSBs, less vulnerable PSBs did not increase their deposit rates likely so as not to signal distress to the market. It was this hike in deposit rates by more vulnerable PSBs that explains their deposit growth. Alternate explanations, such as greater trust in PSBs, can only explain the flight-to-quality component from private sector banks to PSBs but cannot explain why it was the *more* vulnerable PSBs that increased their deposit rates to attract deposits.

Did such deposit flows also impact the quantity and quality of lending? We cannot use the same identification that we used for deposits to examine lending because banks can use their internal capital markets to transfer resources from one branch to another. Instead, we compute for each bank the exposure of each branch to public sector bank branches (which determined deposit flows). We calculate the deposit weighted average of the exposure of each branch within a bank to public sector bank branches. To ensure that these bank branches face similar lending opportunities, we compare lending by different banks within the same district. The lending growth of high MES private sector branches fell by 55.43 pp if the private sector bank branch belonged to a bank with

[7] At that point, only Rs.100,000 (approximately $2000) per depositor per bank was covered by the DICGC. Further, uncertainty and delay in processing deposit insurance claims rendered deposit insurance only partially effective. For example, Iyer and Puri (2012) analyze a bank run at an Indian co-operative bank and find that deposit insurance is only partially effective in preventing runs. They find that even depositors within the insurance limit but with larger deposit balances are likely to run.

[8] In fact, this practice of PSBs increasing their deposits to chase deposit outflows from private sector banks became so rampant that the finance ministry had to step in and stop public sector banks from excessively increasing their deposit rates ("Deposit funds with public sector banks, PSUs told", Business Line, November 11, 2008. http://www.thehindubusinessline.comtodays-paperdeposit-funds-with-public-sector-banks-psus-toldarticle1641219.ece)

high exposure to PSB branches. In stark contrast to the private sector banks, lending *grew* by 56.18 pp for high *MES* public sector bank branches.

One could argue that the increase in deposit base for PSBs is not harmful for the economy as a whole if they are more willing to advance loans to the real economy resulting in much needed credit in times of a crisis. This is consistent with the socially maximizing view of state-owned banks. We do indeed find that more vulnerable PSBs increased lending during the crisis but this was accompanied by a deterioration in borrower quality. Lending rates of the public sector banks with greater exposure to PSB branches was higher by 2.14 pp relative to the less exposed branches, possibly reflecting a deterioration in quality of borrowers. Lending rates of more vulnerable private sector bank branches with high exposure to PSB branches was lower by 2.08 pp, potentially reflecting a cut back in lending to less creditworthy borrowers. Subsequent deterioration in loan performance of more vulnerable public sector bank branches supports this hypothesis. Non-performing asset (NPA) growth of vulnerable public sector branches belonging to banks more exposed to PSB branches increased by a staggering 388 pp compared to a drastic fall of 393 pp in NPA growth of more vulnerable private sector bank branches.

Finally, we document that, consistent with the perception of greater government support in case of stress for weaker PSBs, the government indeed injected more capital into the more vulnerable PSBs.[9]

We also show that our results are robust to alternate explanations. Broadly, our empirical strategy focuses on two endogenous variables: (i) public and private sector banks and, (ii) bank vulnerability. By exploiting a within bank strategy we address the first endogeneity concern. Instead of directly comparing public versus private banks we compare within a private sector bank, branches which have high exposure to public sector bank branches with private sector branches of the *same* bank with low exposure to public sector bank branches. This strategy

[9]While we do not have enough statistical power to relate recapitalizations to our bank vulnerability measure (*MES*), we find that qualitatively high *MES* banks had higher capital injections in Section 8.

helps address the endogeneity concern arising out of a direct comparison of public and private sector banks. Additionally, as described above, by looking at within bank variation we control for banks' lending opportunities. To address the second concern that groups of vulnerable and non-vulnerable banks likely differ on many observable and unobservable characteristics, we conduct a number of robustness checks. We show that our results are not explained by the higher exposure of private sector banks to the global markets, pre-crisis leverage or pre-crisis liquidity. Neither are our results not driven by a too-big-to-fail guarantee and thus not driven by bank size. Importantly, we show that our results hold even during other non-banking crisis. We find a similar flight to more vulnerable PSBs from more vulnerable private sector banks during the Dotcom crash in the early 2000s. Since this crisis was not caused by the financial sector, it helps counter to some extent the argument that our results are purely driven by other pre-crisis characteristics of private sector banks during the 2007–09 crisis.[10]

The rest of the paper is organized as follows. Section 2 describes the related literature. The institutional environment and the time-line of the crisis in India are provided in Section 3. Section 4 presents our empirical hypotheses and discusses the data used in our analysis. Section 5 looks at the impact of government guarantees on stock performance of public and private sector banks. Section 6 and Section 7 look respectively at the impact on deposit growth and bank lending. Section 8 looks at capital injections into the PSBs. Section 9 concludes.

2. Related Literature

Our paper is related to the large literature on government guarantees. The global financial crisis of 2007–09 saw the widespread use of government guarantees to protect failing banks. While these

[10]We also show that the MES is a better measure of systemic risk compared to more traditional measures of firm level risk (volatility and expected loss in an institution's own left tail) and standard measures of systemic risk (*Beta* which is the covariance of a firm's stock returns with the market return divided by the variance of market returns). As Acharya et al. (2017b) note, the difference between the MES measure and *Beta* is that systemic risk is based on tail dependence whereas *Beta* is based on *average* covariance with the market. MES is a better measure of the systemic risk externality arising when the financial sector as a whole is undercapitalized.

guarantees keep markets well-functioning during periods of stress, they may induce banks to take excessive risks [Cordella and Yeyati (2003), Gorton and Huang (2004) and Gropp et al. (2004)]. The empirical literature on government guarantees has focused until recently on the ex-ante impact of government guarantees on bank risk-taking, leverage and cost of capital [Acharya et al. (2014) and references therein]. Our paper addresses the question of how these guarantees distort bank behavior and outcomes *during* crisis periods. Furthermore, one difficulty in analyzing the impact of government guarantees is also accounting for the counterfactual, that is, how would the absence of such guarantees impact bank behavior and outcomes? The mix of state-owned and private sector banks in India allows us to account for the counterfactual and provides an ideal setting to explore impact of government guarantees during crisis periods.

Our work is also tangentially related to the large literature on deposit insurance. This literature suggests that while deposit insurance reduces liquidity risk, it is also associated with significant moral hazard costs.[11] In a similar vein to our findings, Calomiris and Jaremski (2016) find that the creation of the Federal Deposit Insurance Corporation (FDIC) in the US in 1933 led to hitherto uninsured banks increasing their risk-taking. They attribute this increase in risk-taking to reduced market discipline arising from the introduction of deposit insurance.

Our findings are, in fact, consistent with the experience worldwide: financial institutions with greater access to government guarantees have survived the crisis or even expanded post-crisis while the ones without such access have failed or shrunk. A striking case in point has been the growth of the government-sponsored enterprises (Fannie Mae and Freddie Mac) and commercial banks in the United States - both sets of institutions with explicit government support and ready access to central bank emergency lending. These institutions expanded their holdings of mortgage-backed securities while investment banks and hedge funds deleveraged and sold these securities [He et al. (2010)]. Eventually, Fannie Mae and Freddie Mac effectively failed and were put

[11] See Martinez-Peria and Schmukler (2001), Demirgüç-Kunt and Detragiache (2002), Demirgüç-Kunt et al. (2008), Cull et al. (2005) and Calomiris and Chen (2016)

under the United States government conservatorship in September 2008. In contrast, private-label mortgage securitizers lost a significant market share during the crisis and have not recovered since then. Thus, even though access to government guarantees might be considered a source of financial stability during a crisis, our results suggest that greater presence of government institutions in the financial sector (or greater extent of government intervention in a crisis) is likely to be associated with the misfortune of crowding out the private financial sector in the long run.

3. The Indian Banking Sector and the Crisis of 2008

Historically, Indian banks have been wholly owned by the government. In the 1990s, after economic liberalization, the government reduced its stake and allowed private sector banks and foreign players to enter the market. The Indian financial system still has substantive public sector ownership and as of March 2009 accounted for nearly 71.9 percent of aggregate assets. The Indian Bank Nationalization Act provides an explicit guarantee that all obligations of PSBs will be fulfilled by the Indian government in the event of a failure.

Globally, the first signs of the financial crisis of 2008–09 began in June 2007 when a subsidiary hedge fund of the investment bank Bear Stearns which had heavily invested in subprime mortgages had to be rescued. This was followed by the French bank BNP Paribas announcing a freeze on three of the bank's investment funds. Bear Stearns continued to write-down its subprime portfolios and as investor losses mounted, the Federal Reserve Bank of New York provided an emergency loan to try to avert a sudden collapse. However, the bank could not be rescued and eventually was sold to JP Morgan Chase on 17th March 2008 at fire sale prices. Financial conditions further deteriorated with Lehman Brothers reporting a loss of $3.9 billion the third quarter of 2008 on September 10th. On September 15th 2008, it finally declared bankruptcy since it was unable to obtain short-term financing or a buyer.

The global financial crisis hit India in 2008 with the Indian stock market losing more than 60 percent of its peak valuation. The stock market index, S&P CNX NIFTY index, declined sharply

starting January 2008. Index prices fell from a peak of 6,288 in January 2008 to 2,524 in October 2008, representing a decline of nearly 60 percent. The BSE index, another market index, similarly fell nearly 59 percent from 20,873 in January 2008 to 8,510 in October 2008. Starting 2008, foreign institutional investors (FIIs) facing a liquidity squeeze from abroad, started pulling out capital from India. In 2008–09, FIIs withdrew nearly Rs. 433 billion (approximately $7 billion). This eventually resulted in a money market and credit squeeze which spilled over into the real economy.[12] The global slowdown also resulted in a slump in demand for exports. This impact was felt economy-wide and Indian GDP fell from 9 percent in 2007 to nearly 6.1 percent in 2008. Eventually, the government of India, fearing an even more rapid deterioration of the economy, announced wide-ranging stimulus packages towards the end of 2008 that appeared to temporarily restore the economy back to its pre-2008 growth.

Before 2008, private banks such as ICICI Bank, Karnataka Bank, Lakshmi Vilas Bank and Kotak Mahindra topped the list of banks with highest delinquent assets, also called non-performing assets (NPAs). The scenario changed drastically in the aftermath of the crisis. After 2008, the gross non-performing assets of the PSBs grew almost six times to Rs. 3,416 billion (approximately $ 53 billion) in March 2016 and PSBs such as State Bank of India (SBI) and Indian Overseas Bank topped the list of banks with highest NPAs.

4. Empirical Analysis

4.1. Testable Hypotheses

In Appendix A, we motivate our empirical approach with a simple model. We hypothesize that during periods of crises franchise values of more vulnerable banks that are protected by government guarantees (PSBs) increase relative to unprotected banks (private sector banks). Additionally, we derive implications for the difference in franchise values of more vulnerable

[12]Duvvuri Subbarao,"Impact of the Global Financial Crisis on India Collateral Damage and Response", Feb 18, 2009.http:www.rbi.org.inscriptsBS_SpeechesView.aspx?Id=410

PSBs relative to safer PSBs, and this relative difference for private sector banks which are not guaranteed by the government.

Here we summarize the intuition for the setup and its empirical implications. In our model, we assume that if banks fail only due to an idiosyncratic shock, then they are not guaranteed by the government and there is no difference in this outcome between private sector banks and PSBs. In contrast, in the event of an aggregate crisis, a private sector bank with high vulnerability (exposure) to the crisis will lose its market share of deposits translating into lower cashflows. The cash (deposit) outflows from failing private sector banks are captured by the remaining banks, namely all the PSBs and the less vulnerable (in the context of our empirical setting, low MES) private sector banks. While only the less vulnerable private sector banks survive an aggregate crisis unscathed, all PSBs survive regardless of their ex-ante exposure to aggregate risk as they enjoy government guarantees.

We parameterize the split in the capture of market share between less vulnerable banks (low MES private sector banks and low MES PSBs) and the more vulnerable (high MES) PSBs with the parameter ϕ. A low ϕ implies that the high MES PSBs are able to attract a greater share of the demand for deposits from the failing private sector bank. Let ΔV^{PSB} represent the difference in franchise values between the high MES and low MES PSBs. ΔV^{Pvt} is analogously defined.

This simple model yields the following testable predictions:

1. As the probability of the aggregate crisis increases, ΔV^{Pvt} *decreases* for private sector banks.
2. As the probability of the aggregate crisis increases, ΔV^{PSB} *increases* for PSBs if government guarantees are strong for all PSBs *and* if $\phi < 0.5$.

The intuition for the above two predictions is as follows. First, since private sector banks do not have explicit government guarantees, the more vulnerable private sector banks will perform worse than the less vulnerable private sector banks during a crisis.

To obtain the second prediction, a necessary condition is that PSBs have government guarantees in a crisis. Since only PSBs are guaranteed during the crisis, there should be a flight

of deposits from the vulnerable private sector banks to the remaining banks (all PSBs and the less vulnerable private sector banks). This would be consistent with a "flight-to-quality" story. However, this would not be sufficient to generate our empirical finding that more vulnerable PSBs have higher deposit growth during the crisis compared to safer PSBs. For this to be true, we also need that $\phi < 0.5$. That is, vulnerable PSBs need to *actively* attract deposits away from the failing vulnerable private sector banks. This would be true if, say, more vulnerable PSBs gamble and manage to attract deposits away from surviving banks — for example, by increasing their deposit rates — in effect, exploiting or receiving greater value from government guarantees compared to safer PSBs. Safer PSBs, on the other hand, may not be willing to raise their deposit rates due to signalling concerns.

Hypothesis 1. *More vulnerable PSBs, i.e., banks with greater aggregate risk exposure, had higher returns during the crisis compared to less vulnerable PSBs. Analogously, more vulnerable private sector banks had lower returns compared to less vulnerable private sector banks.*

Next, we conjecture that this pattern in stock returns is explained by deposit flows of PSBs and private sector banks.

Hypothesis 2. *More vulnerable PSBs have higher deposit growth compared to less vulnerable PSBs. In contrast, more vulnerable private sector banks have lower deposit growth compared to less vulnerable private sector banks.*

To explain the cross-sectional heterogeneity of more vulnerable PSBs growing their deposits relative to less vulnerable PSBs, we need that the more vulnerable PSBs were actively going after the deposit flows from private sector banks, say by increasing their deposit rates (low ϕ in the model). This leads to the following hypothesis.

Hypothesis 3. *Greater deposit growth for PSBs with greater vulnerability to a crisis is due to them increasing their deposit rates.*

4.2. Data Used and Measure of Bank Vulnerability

We use two main data sources. The main data based on annual financial statement of banks is publicly available and provided by the Reserve Bank of India (RBI). Since our measure of bank vulnerability (described below) requires stock market returns we use all publicly listed PSBs and private sector banks in India in our analysis. Of the 50 public and private sector banks, for which the RBI provides annual financial statements data, 38 banks (excluding Industrial Development Bank of India (IDBI)) are publicly listed of which 21 are PSBs and 17 are private sector banks. Our data on the Indian stock market is from the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE).

For the within bank analysis we use branch level data, Basic Statistical Returns, which is collected by the Reserve bank of India (RBI) for regulatory purposes. This data has previously been used by Das et al. (2016), Cole (2009a) and Kumar (2016). This dataset provides deposits and credit at the branch level. We use data for the period 2008 to 2009. Data is reported as of March 31^{st} of every year. Deposit data is available at the branch level for every bank in India. Deposit data is further comprised of current (short-term), savings and term (long-term) deposits. We have both the volume of deposits in rupees as well as number of accounts. In addition, we also have information on branch-level personnel characteristics such as staff strength and whether the branch caters to an urban population. Branches classified as rural if they belong to census city centers with a population of up to 10,000 and urban otherwise. In our analysis, we classify a branch as urban if it is either urban or metropolitan. Lending data is also at the branch level. Sector-wise lending is also provided for the following sectors: services, agriculture and industrial. Data on non-performing assets (NPAs) is also provided for the agricultural and non-agricultural sectors.

For within bank analysis, we focus on regional variation in deposit flows at the district level. Districts can be thought of as regions which are economically integrated and comparable to counties within the US. Only districts for which the private sector bank deposit share is greater

than one percent are retained in the analysis. 287 of 630 districts were retained in the analysis.

In our analysis, we use the Marginal Expected Shortfall (MES) to measure the ex-ante vulnerability of public and private sector banks to an aggregate crisis. The MES measure captures the tail dependence of the stock return of a financial firm on the market as a whole. The strength of the measure lies in its ability to predict which firms are likely to be worst affected when a financial crisis materializes, as demonstrated by Acharya et al. (2017b) in their analysis of the systemic risk of large U.S. financial institutions around the financial crisis of 2007–09.

Specifically, MES estimates the expected losses for a stock conditional on a crisis. Since extreme tail events such as a mild financial crisis happen once a decade and severe crisis such as the Great Depression or the Great Recession only once in several decades, the practical implementation of MES relies on "normal" tail events. We use the normal tail events as the worst 5 percent market outcomes at daily frequency over the pre-crisis period. In our analysis, we take the 5 percent worst days for the market returns as measured by the S&P CNX NIFTY index during the period of 1st January, 2007 to 31st December, 2007, and then compute the negative of the average stock return for any given bank for these 5 percent worst days. Table A.1 in the appendix shows the MES measures for public and private sector banks using January 2007 to December 2007 as the measurement period. As such, MES is a statistical measure but Acharya et al. (2017b) provide a theoretical justification for it in a model where the financial sector's risk-taking has externalities on the economy whenever the sector as a whole is under-capitalized.[13] In our baseline analysis we use the MES as our measure of ex-ante risk. For robustness, we also define two alternate measures of MES. Modified MES is similar to MES except market return is calculated using all banks in the economy excluding the bank for which MES is being calculated. $W-MES$ is a weighted MES which uses exponentially declining weights (λ=0.94) on past observations to estimate the average equity returns on the 5 percent worst days of the market.

[13]They show that the MES measure can be interpreted as one piece of the contribution of each financial firm to the systemic risk in the event of a crisis, the other piece being the leverage of the firm.

Crisis period measurements included in this analysis are crisis returns, deposit growth and loan growth. Crisis return is the stock return for the individual banks during the crisis period from January 2008 to February 24, 2009. Market return is based on the S&P CNX NIFTY. RBI provides the balance sheet data reported annually for each fiscal year ending March. Hence, we calculate the deposit growth for the crisis period from data provided by RBI for the period from 31st March, 2008 to 31st March, 2009. 2*–year Deposit growth* is calculated for the period from 31st March, 2008 to 31st March, 2010. Growth in loan advances is also calculated for the same period using RBI data.

Other variables in our analysis include *Beta*, *Global Beta*, *Volatility*, *ES*, *Leverage*, *Log Asset* and *Liquidity*. *Beta* is based on the S&P CNX NIFTY index as the market return. *Global Beta* is based in the MSCI World Index returns. *Volatility* is the annualized daily volatility in the pre-crisis period from January 2007 to December 2007. Expected shortfall (ES) is the expected return of the bank when the bank's return is below its 5th percentile, during the period 1st January 2007 to 31st December 2007. *Leverage* ratio measured as of March 31, 2008 is the ratio of market equity to the quasi–market value of assets measured as (book value of assets - book value of equity + market value of equity). *Log Asset* is the natural logarithm of the book value of asset value measured as of March 31st, 2008. *Liquidity* is the sum of cash in hand, balances with RBI, money at call and short notice, government securities and deposits to the total liabilities as of 31st March, 2008.

5. Government Guarantees: Impact on Stock Returns

Table 1 provides the summary statistics aggregated for all 38 banks and for high *MES* and low *MES* public and private sector banks. High *MES* refers to the top 7 banks within public (or private) sector banks. Remaining are classified as low *MES* banks. The significant loss of value for the bank stocks during the crisis as suggested by the average return of -65.5 percent indicates how trying this period was for the Indian banking industry as a whole. Average *MES* value measured in the pre-crisis period was 4.0 percent. That is, banks had on average negative 4.0 percent returns

on the days the market return (S&P CNX NIFTY) was below its 5th percentile for the pre-crisis period from January 2007 to December 2007. Average MES values were slightly higher for PSBs (3.47 percent for low MES and 5.47 for high MES) compared to private sector banks (3.23 percent flow low MES and 4.69 for high MES).

In Figure 1, the left panel shows the indexed value weighted returns from January 2008 to February 2009. The returns are weighted by their market capitalization. The vertical solid line at 17^{th} March 2008 marks Bear Stearns' fire sale to J. P. Morgan and the vertical dashed line at 15^{th} September 2008 marks the Lehman bankruptcy. The value weighted index fell by more than 60 percent over this period for the private sector banks and by 45 percent for public sector banks. As seen in the graph, the stock index performance for PSBs outperformed private sector banks after the Bear Stearns event but became especially pronounced after the Lehman Brothers bankruptcy.

We now relate stock market performance to bank vulnerability. The right panel of Figure 1 shows the difference in the market-weighted stock index performance between the high and low MES banks for the period January 2008 to February 2008 separately for public and private sector banks. The solid line depicts the indexed market-weighted returns for the difference between the high and low MES private sector banks, while the dashed line represents the same for public sector banks. As before, the day Bear Stearns reached its fire sale to J. P. Morgan, 17^{th} March 2008 is shown as the vertical solid line, while the date of the Lehman bankruptcy, 15^{th} September 2008 is indicated with a vertical dashed line. Before the date of Bear Stearns fire sale, private and public sector banks had almost similar returns for high minus low MES banks but the returns started to diverge from this date. The difference between high and low MES public sector banks increased following the Bear Stearns collapse. In contrast, index returns of the private sector banks declined. This pattern is similar following the Lehman Brothers bankruptcy and the difference between the high and low MES public and private sector banks increased by 27.7 percent. This is consistent with our hypothesis: more vulnerable public sector banks outperformed less vulnerable public sector banks while the opposite was true for private sector banks.

Below, we study the stock performance of these banks more formally using an event study analysis.

5.1. Event Study Analysis

Market reaction is examined by calculating abnormal returns. Abnormal return is defined as the difference between the realized and expected return. The expected return is calculated by using the market model, where for each bank, its stock returns are regressed on the market returns separately over the estimation window which starts 250 days prior to the event window and ends 10 days before the event date.

The equation used for estimation is:

$$R_{i,t} = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t} \tag{1}$$

where, R_i is the individual stock returns over the estimation window and R_M is based on the S&P CNX NIFTY. The coefficients α_i and β_i computed over the estimation window are used for the calculation of the expected returns over the event window. The daily abnormal return is then calculated as the difference between the actual return and the expected return calculated in Equation 1 above:

$$AR_{i,t} = R_{i,t} - E[R_{i,t}] \tag{2}$$

The cumulative abnormal returns (CAR) are calculated by cumulating the abnormal returns across time for the event window.

$$CAR_{i(t_1,t_2)} = \sum_{t=t_1}^{t_2} AR_{i,t} \tag{3}$$

Figure 2 shows the difference in the market-weighted cumulative average returns between high MES and low MES for private and public sector banks. High and low MES banks are defined as

before. Panel (a) shows that the difference in abnormal returns between high and low *MES* PSBs increased after the Bear Stearns collapse. In contrast, this difference in abnormal returns declined for private sector banks with a relative decline of 10 percent compared to PSBs. Panel (b) shows a similar trend following the Lehman bankruptcy with a spread of 7 percent between the relative (high *MES* minus low *MES*) CAR of PSBs versus private sector banks.

Finally, we link the cross-sectional heterogeneity in *MES* to the stock return over the period January 2008 to February 2009. In Figure 3 Panel A, we plot stock returns during the crisis against ex-ante bank vulnerability as measured by *MES*. *MES* is able to explain a significant proportion of returns for both private sector banks (R^2 of 29.70%) and PSBs (R^2 of 46.10%) during the crisis. These plots show that private sector banks with higher *MES* were worse hit during the market-wide downturn. A 1 pp higher *MES* is associated woth a 6.61 pp decline in crisis returns. More vulnerable PSBs, however, had higher stock returns during the crisis. A 1 pp higher *MES* is associated woth a 6.12 pp *increase* in crisis returns. In the absence of guarantees — as in the case of private sector banks — banks with higher ex-ante bank vulnerability should perform worse during the crisis. This trend is consistent with Hypothesis 1 where we conjecture that government guarantees may have helped more vulnerable PSBs perform better during the crisis.

6. Impact on Deposits

We now explore whether the above cross-sectional heterogeneity in stock market performance with bank vulnerability can be attributed to deposit growth during the crisis. We first look at the volume of deposit growth and then provide evidence for deposit rates. One empirical strategy is to relate *MES* of private and public sector banks to deposit growth during the period. However, the main identification challenge using this across-bank strategy to show a causal effect of government guarantees on deposit flows is that our results are biased due to omitted variable. One important omitted variable is banks' lending opportunities. For example, if crisis periods result in a decline in lending opportunities especially for the high (low) *MES* private (public) sector banks, then

this could explain why private (public) sector banks contract deposit supply. Another concern could be that high *MES* private sector banks were more exposed to the global crisis and thus witnessed a greater decline in deposits. To establish a direct causal effect of the implicit and explicit government guarantees of public sector banks on deposit supply, we thus need to control for banks' lending opportunities.

6.1. Identification Strategy

We address this challenge by exploiting geographic variation in exposure of a bank branch to public sector bank branches. Since our hypothesis is that the presence of government guarantees results in a flight to quality from private to public sector banks, we hypothesize that deposits at private sector bank branches which are more exposed to other public sector bank branches should witness greater deposit outflows.

The main idea behind the identification strategy is that the deposit flows at a branch are independent of banks' lending opportunity at a specific branch since banks can raise deposits at one branch and lend them at another branch.[14] The empirical strategy compares the supply of deposits across branches *within a bank* located in districts with differing exposure to PSB branches. In Section 7, we empirically test the identifying assumption and show that a bank's lending in a given district is unrelated to PSB presence in the local deposit-market within a district.

6.2. Within-bank estimation

We now describe our empirical specification based on branch-level data which uses within-bank variation to control for differences in banks' lending opportunities. For a branch *i* located in

[14] A large literature shows that banks use their internal capital markets to move deposits raised in one area to another depending on loan demand (Gilje et al. (2013) and Drechsler et al. (2018)).

district d belonging to a bank j we run the following specification:

$$\Delta Y_{i,j,d(08-09)} = \alpha_j + \delta_d + \beta * MES_j * \mathbb{1}_{PSB\,branch\,share,d} +$$
$$\phi * \mathbb{1}_{PSB,j} * \mathbb{1}_{PSB\,branch\,share,d} + \gamma * MES_j * \mathbb{1}_{PSB\,branch\,share,d} * \mathbb{1}_{PSB,j} + \varepsilon_{i,j,d} \quad (4)$$

where α_j is the bank fixed effect and δ_d is the district fixed effect. The dependent variable is the deposit growth rate for the period starting from 31st March 2008 to 31st March, 2009.[15] $\mathbb{1}_{PSB\,branch\,share,d}$ is at the district level d and is 1 if the share of deposit as of 31st March 2008 of PSB banks within a district is in the top two terciles. $\mathbb{1}_{PSB,j}$ is 1 for public sector banks and 0 for private sector banks. All other lower order interaction terms are absorbed by the fixed effects. The key set of controls are the bank fixed effects α_j, which absorbs all differences between banks. Intuitively, we are comparing branches of the same bank and asking whether for a bank with higher vulnerability as measured by MES the bank's branches in districts more exposed to PSB branches experience larger outflows relative to branches with lower exposure to PSB branches. By including bank fixed effect we are controlling for any changes in the bank's lending opportunities under our identifying assumption that banks are able to allocate funds internally. District fixed effects (δ_d) control for regional differences. The above equation is our baseline regression. In a supplementary specifications we also look at longer term effects with the dependent variable as the deposit growth from 31st March 2008 to 31st March 2011.

Figure 4 shows the geographic variation of the PSB branch exposure variable, $\mathbb{1}_{PSB\,branch\,share,d}$. The districts classified as 1 are shown in red. As the map shows, there seems to be a wide geographic variation in our exposure variable which helps allay concerns that our results are purely driven by geographic differences.

Table 2 shows that roughly half the bank branches were in these high exposure districts. Among the low (high) MES private sector bank branches, 30 (40) percent of the branches were

[15] Deposit data is provided by RBI annually for the period ending March 31st of each year. Hence the annual deposit growth is calculated from March of previous year to March of current year.

in the high exposure districts. In comparison, 60 percent of the PSBs were in the high exposure districts.

6.3. Growth in Deposits

RBI estimates indicate that deposits of PSBs grew by 26.9 percent during the crisis (March 2008 to March 2009) compared to 23.1 percent a year earlier (March 2007 to March 2008). In comparison, for private sector banks deposit growth slowed from 22.3 percent to a mere 9.1 percent in the same period. In Figure A.2 we plot the cumulative quarter-on-quarter deposit growth from December 2007 to June 2009 separately for public and private sector banks.[16] Starting with the Bear Stearns collapse in March 2008 (denoted by the solid black line) the public sector banks outgrew their deposit base relative to the private sector banks. This divergence is even more pronounced following the Lehman collapse in September 2008 (denoted by the dashed grey line). Looking at this aggregated data one might conclude that a mere flight-to-quality led to PSBs increasing their deposit base at the expense of private sector banks. The aggregated data, however, masks significant heterogeneity across bank vulnerability within public and private sector banks. In Table 1, we see that deposit growth of high MES public sector banks was slightly higher at 22 percent compared to 20 percent for low MES public sector banks. In sharp contrast, deposit growth of high MES private sector banks was a much lower 3 percent compared to 24 percent for low MES private sector banks.

As a supplementary analysis we first relate deposit growth at the bank level to MES separately for public and private sector banks. Figure 3 Panel B shows this univariate analysis relating deposit growth during the crisis to ex-ante bank vulnerability as measured by MES. Growth in deposits for PSBs was strikingly different from that for private sector banks during the crisis. While more vulnerable private sector banks had lower deposit growth, more vulnerable PSBs had

[16]While the above estimates refer to all 50 banks for which data is provided by RBI, the deposit growth also show similar patterns when we restrict to the 38 banks used in our analysis). Quarterly data from RBI is not available bank-wise and only provided at the aggregated level by bank type: public sector banks and private sector banks. Hence, we cannot do an event study analysis version of deposit growth with high and low MES analogous to panel (b) Figure 1.

higher deposit growth during the crisis. A bank level analysis, however, may be confounded since the cross-sectional heterogeneity may merely reflect differences in lending opportunities of banks during the crisis.

Instead, we turn to branch-level data using the regression specification in Equation 4 with the dependent variable, *Deposit growth*, measured for the crisis period from 31st March, 2008 to 31st March, 2009 in Table 3. Table 3, Columns 1 shows that high *MES* private sector bank branches with high exposure to PSB branches witnessed a 4.49 pp decline in deposit growth relative to branches with low exposure to PSB branches as seen by the interaction coefficient $MES * \mathbb{1}_{PSB\,branch\,share}$. On the other hand, as the coefficient $MES * \mathbb{1}_{PSB\,branch\,share} * \mathbb{1}_{PSB}$ implies, the deposit growth at the branches of the high *MES* PSBs in these districts *increased* by 4.038 pp compared to the private sector branches. In fact, these effects persist over the longer term and do not revert back following the crisis. In Panel B, Table 3 we repeat the above specification where the dependent variable is the 3 year deposit growth rate from 31st March 2008 to 31st March, 2011. The effects are even stronger over the longer term. Deposit growth at the more exposed vulnerable private sector branches reduced by 12 pp, while the deposit growth *increased* by 11 pp at the nearby high exposure vulnerable PSB branches.

A flight to quality channel can only explain deposits moving from private sector bank branches to PSB branches, but not to more vulnerable PSBs relative to less vulnerable PSBs. Depositors should penalize banks with greater ex-ante bank vulnerability and move money from the more vulnerable banks, which are likely to fail during a crisis, to banks with lower vulnerability. We conjecture (Hypothesis 2) that, government backing of PSBs distorts bank behavior during aggregate crisis. We show below that more vulnerable PSBs, which are government guaranteed, were increasing their deposit rates to attract more deposits.

6.4. Deposit Rates

Why did depositors move deposits to the more vulnerable PSBs and not to the safer PSBs? Did vulnerable PSBs increase their deposit rates to attract deposits? We examine this in two

ways. First, we exploit heterogeneity in government regulation of deposit rates across deposits of different types to test the link between deposit rates and growth in deposits. Second, we look directly at deposit growth in different deposit rate brackets.

Deposits can be classified into a) demand deposits; b) savings bank deposits; and, c) term deposits. Demand deposits, which account for 11 percent of all deposits, are short maturity deposits and are withdrawable on demand. Saving deposits, which account for 20 percent of all deposits, are a form of demand deposit and are subject to restrictions on withdrawals. Term deposits, which account for the majority (69 percent) of all deposits, are for a fixed period typically longer than the maturity of demand deposits. One important distinction between these different deposit types is that while banks were able to set deposit rates for demand deposits and term deposits, rates of savings deposits were heavily regulated by the government during this period.[17] We exploit this difference in regulation of deposit rates to determine whether banks were actively increasing deposit rates to attract deposits.

Table 3 shows the regression results for Equation 4 with the dependent variable as the growth rate of deposits for each category of deposits. Demand deposits grew on average by 13.58 pp for high MES private sector branches that had high exposure to PSB branches (see column 2, Panel A Table 3). Vulnerable public sector bank branches in these areas witnessed a fall in demand deposit of 17.6 pp. Savings deposit growth did not vary for the high MES public and private sector bank branches. Term deposits, on the other hand, fell by 10.8 pp in private sector branches more exposed to public sector bank branches. High MES public sector branches in these districts *grew* their term deposits by 10.2 pp. Note, the entire effect of the decline in deposits of high MES private sector branches and a resulting growth in PSB branches in column 1 is driven by the growth in term deposits which are longer maturity deposits. Depositors perceived private sector banks to be more vulnerable and shifted deposits to the lower maturity demand deposits whereas

[17] It was only after October 2011 that savings deposits were deregulated and banks were able to change deposit rates (see "Deregulation of Savings Bank Deposit Interest Rate - Guidelines", October 25, 2011 `https://www.rbi.org.in/scripts/NotificationUser.aspx?Id=6779&Mode=0`).

for PSBs depositors shifted to the higher maturity term deposits in line with a flight-to-quality story. Since savings deposit rates are set by the government of India, the more vulnerable PSBs cannot increase their deposit rates to attract deposits. Thus, the relationship for savings deposit growth is not significant for public sector banks branches as one would expect if PSBs were not able to change their deposit rates.

As with the overall deposit growth, the results persist over the longer 3 year period with high MES private sector branches in districts more exposed to public sector bank branches losing term deposits (29.8 pp decline) and nearby public sector bank branches gaining term deposits (29.43 pp increase).

We now turn to deposit growth in different deposit rate brackets within the term deposits. Table 4 shows the regression results for Equation 4 with the dependent variable as the growth rate of deposits for deposits with deposit rates less than 8 percent and deposits with deposit rates greater than 8 percent. Within each category we also have the break-up by retail depositors and wholesale depositors. There was no differential impact on deposits with deposit rates less than 8 percent (column 1). This is true even when we split the deposits into retail and wholesale deposits (column 2 and column 3). However, when we look at the deposits with deposit rates greater than or equal 8 percent we see our familiar result. Deposits in this rate bracket fell by 11.66 pp in more vulnerable private sector branches exposed to public sector bank branches. High MES public sector branches in these districts *grew* their term deposits by 14.48 pp. The entire effect of the decline in deposits of high MES private sector branches and a resulting growth in PSB branches is driven by the retail sector deposits.

6.5. Robustness tests

In this subsection (i) characterize branches that experienced runs, (ii) explain what the MES measure captures and compare it to alternate risk measures, and (iii) show that our results are robust to alternate explanations.

Branch Characteristics

In Panel A Table 5, we characterize the branches which witnessed a flight of deposits. In column 1, the dependent variable is 1, if it is above the median share of unskilled staff. We see that the private sector branches that were exposed to more PSB branches had higher unskilled staff (13.4 percent) and the public sector bank branches that witnessed an inflow of deposits had more skilled labor (9.4 percent). In column 2, the dependent variable is 1 when a branch is located in the urban area. High exposure private sector branches had lower presence in the urban areas (6.5 percent lower) and the public sector branches that witnessed an inflow of deposits were 5.7 percent more likely to be located in urban areas possibly indicating it was the more sophisticated depositors that fled private sector bank branches. We find that the branches that witnessed runs don't differ in their exposure to non-performing assets, their credit to deposit ratios and their size. This is shown in columns 3-5 where we repeat our baseline specification where the dependent variables is 1 if it is in the above median NPA share of loans of branches (column 3), the dependent variables is credit to deposit ratio (column 4) and the dependent variable is 1 if it is above the median of log deposits across all branches (column 5).

MES and alternate risk measures

Next, following Acharya et al. (2017b) in Table A.2 we compare the MES measure to alternate measures of risk. First, we focus on two measures of firm level risk, namely the annualized standard deviation of returns based on daily stock returns, Vol; and expected shortfall (ES) defined as the negative of the firm's average stock return in its own 5 percent left tail. Second, we look at the standard measure of systemic risk, $Beta$, which is the covariance of a firm's stock returns with the market return divided by the variance of market returns. In contrast to MES, neither the firm-level risk measures, Vol (column 1) and ES (column 2), nor the traditional systemic risk measure $Beta$ (column 3) are able to explain the cross-sectional variation in deposit growth of public versus private sector banks. Directionally, the volatility and beta estimates are in the right direction,

however the effects are noisy. *MES* does a much better job of capturing the vulnerability of public and private sector banks (Table 3, Panel A, column 1). Acharya et al. (2017b) find similar results when they use these alternate risk measures to explain variation in returns of US financial firms during the 2007–09 financial crisis. As Acharya et al. (2017b) note, the difference between the *MES* measure and beta is that systemic risk is based on tail dependence whereas *Beta* is based on *average* covariance with the market. The *MES* measure captures the propensity of each bank to be undercapitalized when the financial sector as a whole is undercapitalized. Thus, *MES* is a better measure of the systemic risk externality arising when the financial sector as a whole is undercapitalized.

Figure 5 relates *MES* to returns before the crisis from January 2007 to December 2007. Both high MES public and private sector banks are associated with higher returns during the pre-crisis period (though the relationship is statistically insignificant for PSBs). This is in contrast to our baseline analysis in Figure 3 Panel A, wherein the crisis period returns are negatively associated with MES for private sector banks but positively associated with MES for PSBs. We expect high MES banks to have higher stock returns during non-crisis periods and for this relationship to turn negative during crisis periods as in the case of private sector banks. In contrast while the relationship between MES and returns is (weakly) positive for public sector banks during non-crisis periods, it continues to remain positive during crisis periods too. Government guarantees, thus, distort public sector bank behavior during crisis periods resulting in the outperformance of high MES PSBs.

What is important for our analysis is whether a ranking of banks based on the normal-time *MES* works well during the crisis. In Figure 6, we plot *MES* rankings from January 2006 - December 2006 against the *MES* rankings from January 2007 - December 2007 and show that *MES* rankings in 2006 were reflective of which banks would be systemically important in 2007.

Further, in Table 5, Panel B we show that the outflow from private sector bank branches and inflow to public sector bank branches was a feature of only the crisis period. In Panel A we repeat

our specification for the annual growth in deposits from 2005 to 2008. The annual growth rate in deposits for 2005 is calculated from 31st March, 2004 to 31st March, 2005 (column1). Similar calculations are carried out for the other years. As seen in column 1-4, the high MES private sector bank branches witnessed a higher deposit growth rate in areas which were more exposed to PSB sector branches relative to the ones that had less exposure to them for all the years. High MES Public sector banks on the other hand had lower deposit growth in these areas. That is, private sector bank branches were growing in these areas relative to public sector bank branches before the crisis.

In Table A.3, we also show that our baseline results on deposit growth are robust to alternate definitions of MES. In column 1, we define a modified MES based on the tail events in the financial sector. Modified MES is similar to MES except market return is calculated using all banks in the economy. Additionally, since some banks may be driving the financial sector returns we calculate the financial sector return by excluding the bank for which MES is being calculated. Column 1 shows our familiar result. We also define a weighted MES ($W-MES$) which uses exponentially declining weights (λ=0.94) on past observations to estimate the average equity returns on the 5 percent worst days of the market. The results are qualitatively similar.

Robustness to alternate explanations

Broadly, our empirical strategy looks at the impact on two endogenous variables: (i) public and private sector banks and, (ii) bank vulnerability. By exploiting a within bank strategy we address the first endogeneity concern. Instead of directly comparing public versus private banks, we are comparing within a private sector bank branches which have high exposure to public sector bank branches with private sector branches of the *same* bank with low exposure to public sector bank branches. This strategy helps address the endogeneity concern arising out of a direct comparison of public and private sector banks.

To address the second concern that groups of vulnerable and non-vulnerable banks likely differ on many observable and unobservable characteristics, we conduct a number of robustness checks.

For example, it could be that depositors flee not due to high vulnerability of private sector banks but because of other differences such as their higher exposure to the global crisis. Thus, if the vulnerable banks private sector banks caused the crisis due to their greater exposure to the global markets in the period before the crisis, then one could argue that what we see is simply a reversal of deposit flows in the crisis period away from failing private sector banks. Any alternate explanation will however need to explain why it was the *more* vulnerable public sector banks that witnessed a growth in deposits. Nonetheless we conduct a number of tests to show that our results are robust to several alternate explanations.

First, we show that our results are not explained by the higher exposure of private sector banks to the global markets. One could argue that it was the higher global exposure of more vulnerable private sector banks and lower global exposure of more vulnerable public sector banks that is driving our results. In column 3, Table A.2 in the appendix we look at deposit growth against global beta which measures sensitivity to the MSCI World market index. The coefficient on the triple-interaction term shows that it was not the low global exposure public sector bank branches that were gaining deposits. In column 3 we also add the beta coefficient which measures sensitivity to the domestic NSE stock market index. The coefficients on beta and global beta again assure us that our results are not being driven by public sector banks with low exposure to the global markets. Note, the coefficients are insignificant and directionally too the public sector banks with higher global exposure gained deposits consistent with our MES results. As argued above the MES is a better measure of systemic risk.

Another argument is that pre-crisis leverage can explain our results. In Table A.3 we show that the deposit growth is not driven by leverage. Financial leverage is measured as of March 31st 2008 and is defined as the quasi-market assets to equity ratio. In our analysis we have emphasized the role of explicit and implicit government guarantees that PSBs enjoy. We explore whether a too big to fail guarantee is driving the results. The model in the appendix Section A does not distinguish between the two types of guarantees and would yield similar empirical hypothesis. In column 4,

we look at the variation across the size of banks measured as the log of assets. We find that the deposit growth results are not driven by the too big to fail guarantees of PSBs. One could argue that private sector banks might face liquidity problems during the crisis which may be driving our results. In column 5 we show that our results are not driven by differences in the liquidity of banks.

Finally, we show that our results hold even during other crisis periods. One argument is that private sector banks could have caused the financial crisis in India and our findings are driven by the poorer performance of these private sector banks during the crisis. We look at the Dotcom crash which lasted from March 11th 2000 to October 9th 2002. In column 5 Table 5 we look at deposit growth for the period from 31st March, 2000 to 31st March, 2003. Consistent with our findings for 2007–09 crisis, we find that deposits at more vulnerable private sector banks declined by 43.3 percent whereas deposits at more vulnerable PSBs increased by 42.8 percent. Since the Dotcom crash did not originate in the banking sector, it is hard to argue that our results are simply a feature of a banking crisis.

7. Impact on Bank Lending

We now examine whether the increased flow of deposits into PSBs translated into an increased flow of credit to the real economy. In line with the higher deposit growth for PSBs in Section 6, we find that credit did indeed grow at a higher 21 and 22 percent for low and high *MES* PSBs. In comparison, high *MES* private sector banks grew by a much lower 6 percent compared to a higher 23 percent for low *MES* private sector banks (see Table 1). There are several reasons why state-owned banks may not cut back on lending during crises. One argument is that vulnerable PSBs are socially maximizing and therefore increase lending during crises and are thus helpful in maintaining credit flow in the economy during crises periods. In contrast, a political economy view suggests that political pressure leads to public sector banks lending during crises but may also result in funding of inefficient investments. Prior literature too suggests that lending of state-owned banks react to electoral cycles. For example, Sapienza (2004) finds that banks lend at lower

interest rates to firms affiliated with the political party of the lending banks. Dinç (2005), too, finds that state-owned banks increase lending in election years compared to private sector banks.

Both the social motive and the political motive result in greater lending and subsequently higher investment. The difference, however, is that in the former, state-owned banks invest in projects which are welfare maximizing whereas in the latter state-owned banks invest in inefficient projects based on political motives. To see which of the above motives were responsible for increased lending by banks we turn to the data. We examine the impact of crisis time guarantees on both the amount of lending as well as on bank lending rates.

7.1. Identification Strategy

In this section we analyze the effect of the contraction in deposit supply induced by the flight of deposits on lending. If private sector banks are not able to compensate for the drop in deposits with other sources of funding, then we will see an overall fall in lending. However, if banks use their internal capital markets to allocate deposits across branches then the impact on lending is not geographically localized. Hence, we cannot use the same strategy for identification that we used in Section 6 for deposits. Instead, we calculate a bank-level measure which captures the impact of the deposit contraction by averaging at the bank level the exposure of the bank's branches to other public sector bank branches.

The hypothesis is that private sector bank branches that raise deposits in high PSB exposure markets should reduce lending relative to banks that raise deposits in low PSB exposure markets. To control for differences in lending opportunities we compare the lending of different branches in the same district. This is consistent with the identification strategy used in Section 6. The identification strategy relied on the fact that banks were able to allocate funds across branches and thus local deposit flows were not driven by local lending opportunities. We will also explicitly test this assumption in our empirical analysis below.

7.2. Within-district estimation

We now implement our bank-level estimation strategy by first calculating the bank level exposure to PSB branches. The bank exposure is calculated as the weighted average of all branches of a bank in a district:

$$Bank\,PSB\,Exposure_j = \sum_{i \in j} W_{i,j,d} PSB\,branch\,share_d \tag{5}$$

for a bank j with branches i in district d. $PSB\,branch\,share_d$ is the district level measure of PSB share of deposits. The weight $W_{i,j,d}$ is given by

$$W_{i,j,d} = Deposits_{i,d} / \sum_{i \in j} Deposits \tag{6}$$

where, weight of each branch i, of a bank j, in a district d is the deposit of a branch i in district d divided by the sum of deposits of all branches of that bank. $\mathbb{1}_{Bank\,PSB\,Exposure_j}$ is at the bank level and is 1 for above median value of $Bank\,PSB\,Exposure_j$.

Now, our empirical strategy looks at branches within the districts and compares their lending.

$$\begin{aligned} \Delta Y_{i,j,d(08-09)} = \delta_d + \beta * MES_j * \mathbb{1}_{Bank\,PSB\,Exposure_j} + \kappa * MES_j * \mathbb{1}_{PSB,j} + \\ \phi * \mathbb{1}_{PSB,j} * \mathbb{1}_{Bank\,PSB\,Exposure_j} + \gamma * MES_j * \mathbb{1}_{Bank\,PSB\,Exposure_j} * \mathbb{1}_{PSB} + \varepsilon_{i,j,d} \end{aligned} \tag{7}$$

where δ_d is the district fixed effect. The dependent variable is the lending growth rate for the period starting from 31st March 2008 to 31st March, 2009. All other lower order interaction terms are absorbed by the fixed effects. Intuitively, we are comparing branches of the banks which had high exposure to PSB share at the bank level to branches of banks in the same district which had low exposure to PSB share.

As a supplemental regression, we also run the regression specification in Equation 4 with lending growth as the dependent variable to see whether our identifying assumption is satisfied. If

the internal capital markets work well, then we should see no impact or minimal impact of local PSB exposure.

7.3. Volumes

Panel A in Table 6 shows the impact of deposit flows on lending. Column 1 of Table 6 shows that the lending growth of high MES private sector banks declined by 55.4 pp if the private sector branch belonged to a bank that had high exposure to public sector bank branches. However, high MES public sector branches in these districts witnessed a relative increase in lending by 56.18 pp as shown by the coefficient for $MES * \mathbb{1}_{Bank\,PSB\,Exposure} * \mathbb{1}_{PSB}$. We control for lending opportunities by comparing branches within a district. Column 2 repeats the regression specification in Equation 4 to see if there are local effects on lending. That is, did the districts that witness the flight of deposits also show similar declines (increases) in lending of high MES private (public) sector branches. We see that there are no significant effects [18]on local lending thereby providing support to the identifying assumption that banks use their internal capital markets to reallocate deposits across branches and thus local deposit growth is not completely driven by differences in local lending opportunities.

We next look at what sectors drive this higher lending. In columns 3–5 we split loan growth into (i) services lending, (ii) agricultural lending, and (iii) industry lending. In column 3, Table 6 we see that branches of high MES private sector banks which were more exposed to PSB bank branches witnessed a decline in lending to the services sector (42.73 pp) and a decline in lending to the agricultural sector (285.25 pp). There was, however, no impact on lending to the industry sector. This is in stark contrast to the high MES public sector bank branches which witnessed an increase in lending for both service (41.63 pp) and the agricultural sector (271.93 pp). There was no significant impact on the industry sector.

[18]While directionally the coefficients seem to suggest there is some local effect, effects are noisy and magnitudes are much lower compared to the across-bank analysis in column 1.

Industry lending tends to be longer term in nature and relies on relationship lending. Hence, we see less of a significant impact on this sector. The growth in overall lending of public sector banks can be attributed to the services sector and the agricultural sector.[19] Our results are consistent with a political economy theory since lending increased to the agricultural sector which is considered politically important. As Cole (2009b) and Kumar (2017) show, agricultural lending is influenced by politics in India. While political interests may result in increased lending during the crisis period, they may not necessarily be maximizing social welfare as politically motivated lending may result in inefficient investments.

7.4. Lending Rates

We next turn to the impact on lending rates. Panel B of Table 6 shows that more vulnerable private sector branches belonging to banks with greater exposure to PSB branches had significantly lower lending rates (-2.08 pp) as compared to the branches of private sector banks which had low PSB exposure. Branches of more vulnerable PSBs in these areas had relatively higher lending rates (2.14 pp). These differences in lending rates likely reflect differences in quality of borrowers and thus reflect selection effects. More vulnerable private sector banks likely reduce lending, particularly to the least profitable borrowers, and thus have lower lending rates. More vulnerable public sector bank branches on the other hand potentially increased lending to less credit-worthy borrowers and this is reflected in the higher lending rates. We confirm this conjecture by looking at ex-post loan performance in the next subsection.

As before, lending rates are not affected by local conditions (column 2, Panel B Table 6) since banks use their internal capital markets to redirect funding. Column 3-5 of Panel B, Table 6 shows

[19]Our results are also not consistent with the "lazy banking" theory [Banerjee et al. (2005)] which says that managers of state-owned banks face an asymmetric incentive structure wherein they are penalized for making bad loans but do not face harsh consequences for passing on good opportunities. At face value, since PSBs increased lending our results seem to suggest that a "lazy banking" theory [Banerjee et al. (2005)] may not be at play. However, it could be that loan managers are more prone to increase lending to existing customers and thus, we see an increase in lending to the politically important sectors. However, we find that lending increased particularly to sectors that do not rely on relationship lending suggesting that the lazy banking hypothesis is not at play in our context.

the lending rates for (i) services sector; (ii) agricultural sector; and (iii) industrial sector. We see that, in fact, for all the sectors lending rates were lower for the private sector bank branches with higher exposure to PSBs, as the coefficient on the interaction term $\mathbb{1}_{MES*Bank\,PSB\,Exposure}$ indicates. On the other hand for the branches of the more exposed public sector banks, lending rates were higher as can be seen from the coefficient of $\mathbb{1}_{MES*Bank\,PSB\,Exposure*PSB}$.

7.5. Loan Performance

We next turn to the performance of loans during the crisis. We look at non-performing assets (NPAs) and restructured loans between March 2008 to March 2009. Loans are classified as NPA if a borrower misses payments for 90 days (or 180 days in some cases). We use the specification in Equation 7 with the dependent variable as the growth rate of NPA from 31^{st} March, 2008 to 31^{st} March, 2009. Column 1, Table 7 shows the effect of NPA growth on private and public sector banks. The NPA growth fell by 393 pp for the more exposed private sector bank branches and increased by 387.5 pp for the public sector bank branches. As before, column 2 shows that the effects are not driven by local market conditions as shown by the coefficients $MES * \mathbb{1}_{PSB\,Branch\,Share}$ and $MES * \mathbb{1}_{PSB\,Branch\,Share} * \mathbb{1}_{PSB}$.

One concern might be that the NPA results are driven by the large debt waiver program announced by the government in 2008 [see Mukherjee et al. (2014) and Giné and Kanz (2014)]. RBI provides the break-up of NPAs into i) agricultural, and ii) non-agricultural sector. Column 4 shows that private sector NPA for non-agricultural sector saw a reduction of -392.1 pp but public sector NPA growth rose by 389.6 pp for the branches of vulnerable banks with above median exposure to other PSBs, during this period. Thus, the growth in NPAs of more vulnerable PSBs is driven by the non-agricultural sector. Perhaps the *lack* of a relationship between MES and agricultural sector NPA growth may be explained by the waiver program.

8. Capital Injections in PSBs

Next, we look at the extent of capital support provided by the Indian government to the PSBs in the aftermath of the crisis as a direct measure of government support received by different banks. Since the sample of banks that received capital injections is small, we only provide a descriptive study. Evidence suggests that weaker PSBs received greater capital injections. Beginning December 2008, the government announced a number of capital injections for PSBs. In February 2009, the government announced capital injections in 3 PSBs: UCO Bank, Central Bank of India and Vijaya Bank. Further, as part of the 2010-2011 budget, the government announced additional capital infusion in five PSBs: IDBI Bank, Central Bank, Bank of Maharashtra, UCO Bank and Union Bank. The amount of capital injections was determined based on PSB funding requirements and the need for a capital buffer. Effectively, the PSBs which performed the worst during the crisis resulting in high capital depletion were more likely to receive support from the government. As of March 2009, all the banks mentioned above (except Union Bank) had less than 8 percent of Tier 1 capital. Based on the MES measure, these were also among the more vulnerable banks in our analysis. For example, Union Bank had an MES of 5.74 percent and Vijaya Bank had an MES of 5.27 percent. UCO Bank had a relatively lower MES of 4.80 percent. In summary, more vulnerable PSBs did receive greater ex-post government support. Such direct capital support was not provided to more vulnerable private sector banks, consistent with our starting assumption that PSBs have greater government support compared to the private sector banks.

9. Conclusion

In this paper, we examine the relatively strong performance of state-owned banks in India compared to their private-sector counterparts during the global financial crisis of 2007–09. While more vulnerable private sector banks performed worse than less vulnerable private sector banks, vulnerable state-owned banks performed better. We attribute this to the presence of government guarantees which enabled more vulnerable state-owned banks to grow their deposit

base by increasing their deposit rates. They also increased loan advances, especially to politically important sectors. Ex-post, these loan advances have been associated with greater non-performance and restructuring of assets.

These results suggest that the lack of market discipline is an important channel through which state ownership of banks can distort banking decisions. Particularly, our evidence suggests that it is this lack of market discipline during an aggregate crisis — in the form of access to stronger government guarantees — that results in distorted lending by under-performing state-owned banks, sowing the seeds of an eventual slowdown in economic investments [as documented by Acharya et al. (2017a) in India].

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Table 1: Summary Statistics: Bank level data

Variables	All		Public Sector Banks				Private Sector Banks			
			Low MES		High MES		Low MES		High MES	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
					Risk Measures					
MES (in%)	4.00	1.23	3.47	1.32	5.47	0.32	3.23	0.44	4.69	0.67
Volatility (in%)	20.02	7.48	18.08	7.54	23.07	4.43	16.37	5.18	26.04	8.82
Expected Shortfall (in%)	5.54	0.80	5.40	0.52	6.23	0.43	4.91	0.80	5.94	0.76
Beta	0.86	0.29	0.77	0.30	1.14	0.13	0.68	0.20	0.99	0.23
Global Beta	0.70	0.32	0.63	0.38	0.92	0.07	0.50	0.16	0.91	0.30
Modified MES (in%)	4.22	1.04	4.20	0.59	5.27	0.59	3.13	0.57	4.76	1.07
W-MES (in%)	4.57	0.95	4.43	0.50	5.71	0.52	3.55	0.54	5.09	0.63
					Other Variables					
Log Assets (in%)	10.82	1.16	11.35	0.77	11.67	0.57	10.33	1.28	9.59	0.72
Leverage (in%)	17.97	9.63	21.48	10.13	17.99	8.51	14.55	9.85	15.79	8.85
Liquidity (in%)	37.70	5.19	37.59	3.17	36.02	2.69	36.77	3.52	40.95	10.06
Pre-crisis Returns (in%)	9.05	6.45	7.43	4.32	6.08	3.96	8.22	3.31	16.43	10.14
Crisis Returns (in%)	-65.52	12.38	-66.81	11.89	-55.11	12.41	-61.95	8.55	-78.46	5.28
Deposit Growth (in%)	18.40	11.52	20.44	5.06	22.12	4.95	23.96	6.71	2.67	17.47
Credit Growth (in%)	19.20	11.60	21.15	4.62	22.45	5.16	22.91	13.37	6.72	16.21
$\mathbb{1}_{Bank\,PSB\,Exposure}$	0.50	0.51	0.79	0.43	0.86	0.38	0.10	0.32	0.14	0.38
Obs. (Banks)	38		21				17			

This table shows the summary statistics for all the bank-level variables used in our analysis. Data is for 38 banks. Ex-ante bank vulnerability, measured by MES is the marginal expected shortfall of a stock given that the market return is below its 5^{th}- percentile during the period 1^{st} January, 2007 to 31^{st} December, 2007. For the definitions of volatility, expected shortfall, beta, global beta, modified MES, $W-MES$, log asset, leverage and liquidity refer to Table A.2 and Table A.3 in the appendix. *Pre-crisis* (*crisis return*) is based on the S&P CNX NIFTY for the pre-crisis period from 1^{st} January, 2007 (1^{st} January, 2008) to 31^{st} December, 2007 (24^{th} February, 2009). *Deposit* and *credit growth* is for the period March 31^{st} 2008 to March 31^{st}2009. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is at the bank level and calculated as follows. First we calculate the PSB share of deposits for each district. PSB exposure at the bank level is calculated by deposit weighting the PSB share that each branch is exposed to. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is 1 for banks which have above median PSB exposure. High MES refers to the top 7 banks within public (or private) sector banks. Remaining are classified as low MES banks. Data is from RBI. Mean and standard deviation for all banks, low MES private sector banks, high MES private sector banks, low MES public sector banks and high MES public sector banks are shown.

Table 2: Summary Statistics: Branch level data

Variables	All		Public Sector Banks				Private Sector Banks			
			Low MES		High MES		Low MES		High MES	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
$\mathbb{1}_{PSB\,Branch\,Share}$	0.500	0.500	0.600	0.500	0.600	0.500	0.300	0.500	0.400	0.500
					Deposit Variables					
Deposit growth (in %)	29.80	41.0	30.50	39.80	24.80	35.00	43.60	51.10	25.80	55.60
I) Demand deposit growth	61.40	166.30	68.70	173.6	45.10	145.90	51.00	145.60	86.80	209.90
II) Savings deposit growth	24.10	38.90	24.90	37.30	20.70	36.0	30.80	47.20	23.10	50.60
III) Term deposit growth	40.0	65.20	39.70	62.90	33.30	54.30	68.10	87.30	30.70	83.50
a)Deposit Growth: Rate $< 8\%$	-18.40	116.20	-23.10	111.10	-20.70	107.30	11.20	135.10	-2.30	174.80
i) Retail Deposit Growth: Rate $< 8\%$	-11.10	147.80	-11.70	150.10	-22.60	122.80	8.40	149.90	-0.70	204.30
ii) Wholesale Deposit Growth: Rate $< 8\%$	64.0	471.30	34.70	425.50	124.50	557.70	119.20	517.70	115.90	591.20
b)Deposit Growth: Rate $\geq 8\%$	26.50	86.0	25.80	85.60	18.50	77.30	56.60	89.40	-17.40	97.80
i) Retail Deposit Growth: Rate $\geq 8\%$	42.80	127.30	43.50	132.20	27.30	103.80	74.60	117.90	5.0	144.40
ii) Wholesale Deposit Growth: Rate $\geq 8\%$	135.90	568.0	146.90	590.70	103.50	546.30	159.30	523.20	4.90	331.90
					Lending Variables					
Credit growth (in %)	31.40	80.0	29.60	71.80	23.0	63.0	53.0	113.90	58.10	141.0
I) Services credit growth	19.90	48.60	23.0	45.40	9.90	45.80	40.20	67.90	15.60	51.90
II) Agriculture credit growth	77.10	288.40	60.80	257.60	90.40	304.0	97.0	324.60	196.80	472.80
III) Industry credit growth	119.70	442.40	99.90	403.10	133.0	460.80	205.90	574.80	116.90	483.70
Lending Rate	11.90	1.10	11.60	0.90	11.70	0.90	13.40	1	14.50	1.40
I) Lending Rate: Services	11.70	1.60	11.50	1.50	11.50	1.40	12.60	1.70	14.20	2.20
II) Lending Rate: Agriculture	12.60	1.60	12.30	1.40	12.30	1.50	14.10	1.50	15.10	1.70
III) Lending Rate: Industry	11.60	1.70	11.20	1.40	11.50	1.50	13.30	1.80	14.60	2.0
					Non-performing Assets (NPA) Variables					
NPA growth (in %)	72.10	323.70	58.70	290.90	82.30	326.0	132.90	460.0	106.30	425.90
I) NPA growth: Agriculture	-3.60	180.60	-13.10	164.30	1.80	179.50	40.90	248.80	87.80	324.90
II) NPA growth: Other	75.0	321.20	65.50	294.70	83.80	320.0	112.80	433.80	97.20	410.80
Obs. (Branches)	40,362		34,577				5,785			

Summary statistics at the branch level are shown above. For *MES* definitions refer to Table 1. Data is from RBI. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Deposit (demand, savings, and term deposits which are further classified as those with deposit rates less than/greater than equal to 8 percent), credit (services, agriculture and industry) and non-performing assets/NPA (agriculture and other sectors) growth rates (unless otherwise indicated) data is from March 31st 2008 to March 31st 2009. Lending rate is provided at for each sector and loan size bracket at the branch level. We calculate the average for sectors all, services, agriculture and industry across all loan size brackets. Number of observations is the number of branches for which branch-level deposit growth data is available.

Table 3: Deposit Growth

Panel A: Deposit growth

	(1) All Deposits	(2) Demand Deposits	(3) Savings Deposits	(4) Term Deposits
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES	-4.497**	13.588**	-2.704	-10.875***
	(2.214)	(6.831)	(2.067)	(3.024)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES	4.038*	-17.617**	2.831	10.216***
	(2.288)	(7.217)	(2.143)	(3.054)
No. of Obs.	40362	40237	40251	40248
R squared	0.075	0.061	0.077	0.093
Bank-FE	Y	Y	Y	Y
District-FE	Y	Y	Y	Y

Panel B: 3-year Deposit growth

	(1) All Deposits	(2) Demand Deposits	(3) Savings Deposits	(4) Term Deposits
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES	-12.006**	23.890	-7.292	-29.816***
	(5.217)	(20.301)	(5.614)	(7.045)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES	11.005**	-39.091*	6.812	29.435***
	(5.274)	(20.532)	(5.796)	(7.181)
No. of Obs.	39683	39561	39601	39596
R squared	0.077	0.066	0.077	0.085
Bank-FE	Y	Y	Y	Y
District-FE	Y	Y	Y	Y

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table examines deposit growth against ex-ante bank vulnerability for public and private sector bank branches. Deposit growth data is classified into demand deposit, savings deposits and term deposits. In Panel A, deposit growth is for the period from 31st March, 2008 to 31st March, 2009 for each category. In Panel B, deposit growth is for the period from 31st March, 2008 to 31st March, 2011 for each category. Deposits data is from RBI. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. The remaining interaction terms are included but not shown. All columns include bank and district fixed effects. Standard errors are clustered at the district level.

Table 4: Deposit Rates and *MES*

	(1)	(2)	(3)	(4)	(5)	(6)
		Deposit Rates $< 8\%$			Deposit Rates $\geq 8\%$	
	All	Retail	Wholesale	All	Retail	Wholesale
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES	-1.411	-3.619	-1.361	-11.66***	-8.549*	-13.16
	(5.166)	(5.171)	(30.81)	(3.400)	(5.101)	(22.24)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES	3.728	7.374	20.99	14.48***	11.34**	5.389
	(5.345)	(5.310)	(31.62)	(4.162)	(5.388)	(24.10)
No. of Obs.	34795	34664	24284	34874	34826	25532
R squared	0.129	0.141	0.0658	0.147	0.169	0.0558
Bank-FE	Y	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y	Y

This table examines deposit growth by deposit rate against ex-ante bank vulnerability for public and private sector bank branches. Deposit categories are those with deposit rates less than 8 percent and those with deposit rates greater than or equal to 8 percent. We further split each category into retail and wholesale deposits. Deposit growth is for the period from 31st March, 2008 to 31st March, 2009 for each category. Deposits data is from RBI. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. The remaining interaction terms are included but not shown. All columns include bank and district fixed effects. Standard errors are clustered at the district level.

Table 5: Deposit Growth during Crisis and Non-Crisis Years and Characteristics of Branches

Panel A: Characteristics of Branches

	(1) $\mathbb{1}_{Unskilled}$	(2) $\mathbb{1}_{Urban}$	(3) $\mathbb{1}_{NPAShare}$	(4) $\mathbb{1}_{\frac{Credit}{Deposit}}$	(5) $\mathbb{1}_{Large}$
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES	0.134***	-0.065***	-0.001	-7.451*	0.017
	(0.036)	(0.016)	(0.008)	(4.418)	(0.019)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES	-0.094**	0.057***	-0.001	2.542	-0.011
	(0.041)	(0.017)	(0.008)	(22.808)	(0.020)
No. of Obs.	39713	39713	5505	39713	39713
R squared	0.342	0.383	0.165	0.004	0.161
Bank-FE	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y

Panel B: Across Years

	(1) 2005	(2) 2006	(3) 2007	(4) 2008	(5) Dotcom Crash
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES	5.295**	10.457***	5.447***	7.626***	-43.37**
	(2.548)	(2.583)	(2.066)	(1.708)	(20.48)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES	-5.159**	-10.486***	-5.388**	-8.627***	42.81**
	(2.611)	(2.593)	(2.167)	(1.768)	(20.42)
No. of Obs.	35872	36974	37522	37979	15279
R squared	0.105	0.138	0.101	0.104	0.129
Bank-FE	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel A examines the characteristics of bank branches that faced deposit outflows. In Panel A, column 1 the dependent variable is 1 if it is in the above median share of unskilled staff across all branches. In Panel A, column 2 the dependent variable is 1 if the branch is in an urban area. In Panel A, column 3 the dependent variable is 1 if it is in the above median NPA share of loans of branches of a given bank. In Panel A, column 4 the dependent variable is the credit to deposit ratio. In Panel A, column 5 the dependent variable is 1 if it is in the above median of log deposits across all branches. Panel B examines the deposit growth against ex-ante bank vulnerability for public and private sector banks for years 2005 to 2008 and during the DotCom crash (column 5). In Panel A, column 1 deposit growth is for the period from 31st March, 2004 to 31st March, 2005. Similarly, deposit growth rates in column 2, 3 and 4 correspond to the years 2005–06, 2006–07 and 2007–08. MES is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. In column 5 of Panel A MES is calculated for years preceding the Dotcom crash for the period 1st February, 1999 to 1st February, 2000 and deposit growth is for the period 31st March, 2000 to 31st March, 2003. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. The remaining interaction terms are included but not shown. All columns include bank and district fixed effects. Standard errors are clustered at the district level.

Table 6: Lending during the Crisis

Panel A: Credit Growth

	(1)	(2)	(3)	(4)	(5)
	All		Services	Agri.	Industry
$\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	-55.438***		-42.734***	-285.249***	-88.670
	(19.243)		(13.838)	(71.808)	(118.256)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	56.184***		41.634***	271.930***	89.154
	(19.304)		(14.018)	(72.386)	(117.092)
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES		-5.002			
		(6.245)			
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES		6.103			
		(6.262)			
No. of Obs.	40360	40360	25921	29869	33284
R squared	0.044	0.065	0.071	0.046	0.023
Bank-FE	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y

Panel B: Lending Rates

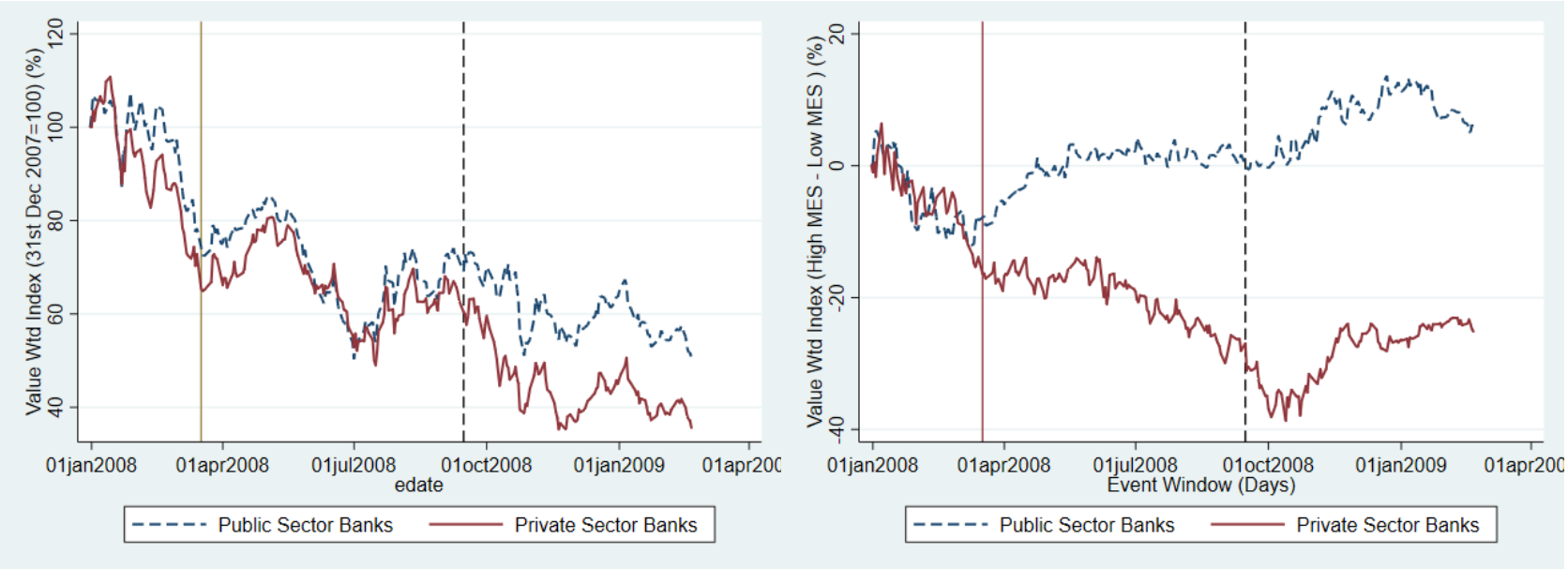
	(1)	(2)	(3)	(4)	(5)
	All		Services	Agri.	Industry
$\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	-2.088***		-1.965***	-1.784***	-1.477***
	(0.156)		(0.146)	(0.331)	(0.235)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	2.142***		1.928***	1.812***	1.639***
	(0.155)		(0.146)	(0.334)	(0.235)
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES		0.052			
		(0.042)			
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES		-0.064			
		(0.045)			
No. of Obs.	189639	189639	162159	68474	108263
R squared	0.244	0.355	0.336	0.192	0.257
Bank-FE	Y	Y	Y	Y	Y
District-FE	Y	Y	Y	Y	Y

Panel A examines credit growth against ex-ante bank vulnerability for public and private sector banks. Credit growth is for the period from 31st March, 2008 to 31st March, 2009 for each category and divided into services, agricultural and industry lending. Panel B shows loan rates against *MES*. Lending rate is provided for different loan size brackets. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. Data is from RBI. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is at the bank level and calculated as follows. First we calculate the PSB share of deposits for each district. PSB exposure at the bank level is calculated by deposit weighting the PSB share that each branch is exposed to. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is 1 for banks which have above median PSB exposure. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. All columns include district fixed effects. All the columns in both the panels also include bank fixed effects. All columns in Panel B also includes a fixed effect for loan size bracket. The remaining interaction terms are included but not shown. Standard errors are clustered at the district level and shown in parenthesis.

Table 7: Non-performing Assets and Restructured Loans

	(1)	(2)	(3)	(4)
	Total		Agri	Non-Agri
$\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	-392.9***		-61.88	-392.1***
	(115.9)		(96.85)	(137.2)
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{Bank\,PSB\,Exposure}$ * MES	387.5***		55.71	389.6***
	(118.4)		(97.25)	(140.0)
$\mathbb{1}_{PSB\,Branch\,Share}$ * MES		-1.386		
		(19.23)		
$\mathbb{1}_{PSB}$ * $\mathbb{1}_{PSB\,Branch\,Share}$ * MES		10.49		
		(20.10)		
No. of Obs.	24143	24143	8475	21498
R squared	0.0253	0.104	0.0639	0.0227
Bank-FE	Y	Y	Y	Y
District-FE	Y	Y	Y	Y

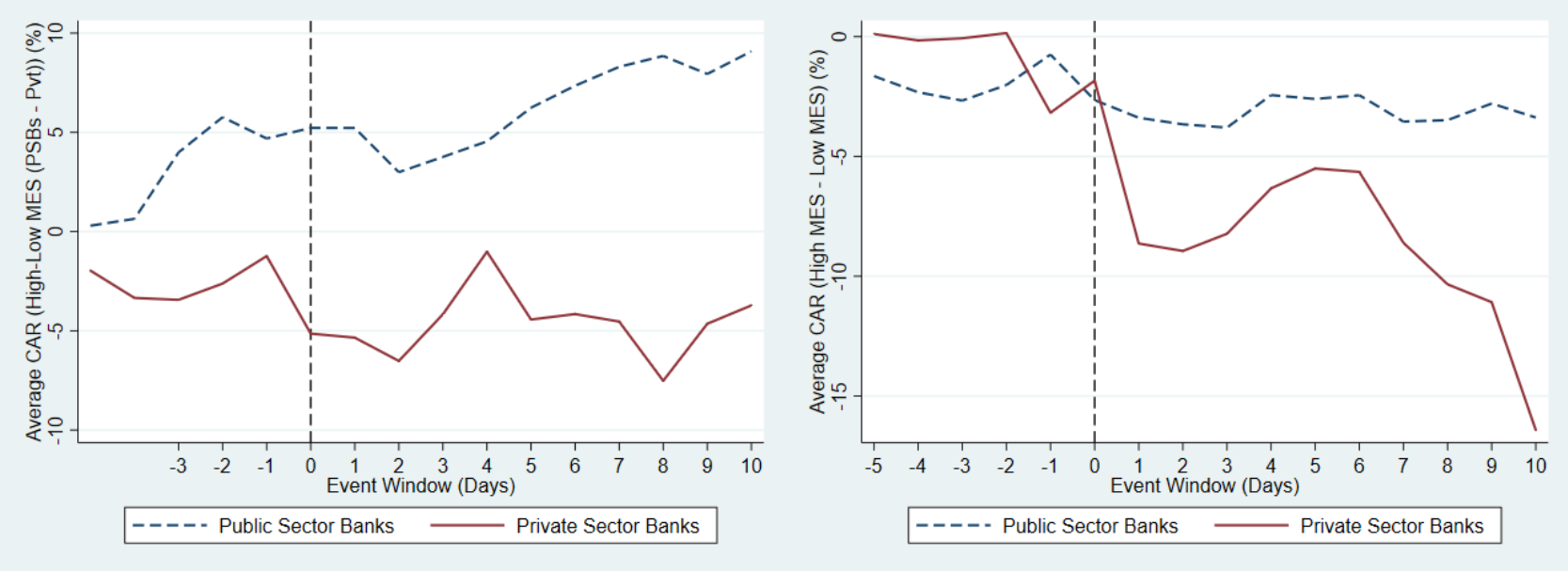
This table examines non-performing asset (NPA) growth against ex-ante bank vulnerability for public and private sector banks. NPAs are classified into agricultural and other lending. NPA growth is for the period from 31st March, 2008 to 31st March, 2009 for each category. MES is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is at the bank level and calculated as follows. First we calculate the PSB share of deposits for each district. PSB exposure at the bank level is calculated by deposit weighting the PSB share that each branch is exposed to. $\mathbb{1}_{Bank\,PSB\,Exposure}$ is 1 for banks which have above median PSB exposure. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. The remaining interaction terms are included but not shown. Standard errors are clustered at the district level and shown in parenthesis.



(a) **Stock Index** (b) **Stock Index of High MES vs. Low MES**

Figure 1: Stock Index Performance of Private and Public Sector Banks

The left panel shows the indexed value weighted returns for the private and public sector banks used in our analysis weighted by their market capitalization for the period starting January 2008 to February 2009. The solid line depicts the indexed value weighted returns for the private sector banks, while the dashed line represents the same for the public sector banks. Returns are indexed to 31st December, 2007. The right panel shows the index performance for the same period for the difference between the high and low MES banks. The solid line depicts the difference between the high and low MES private sector banks, and the dashed line represents the same for the public sector banks. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. High *MES* refers to the top 7 banks within public (or private) sector banks. Remaining are classified as low *MES* banks. The solid vertical line depicts the date of the Bear Stearns collapse (17th March 2008) and the solid dashed line depicts the date of the Lehman bankruptcy (15th September 2008).

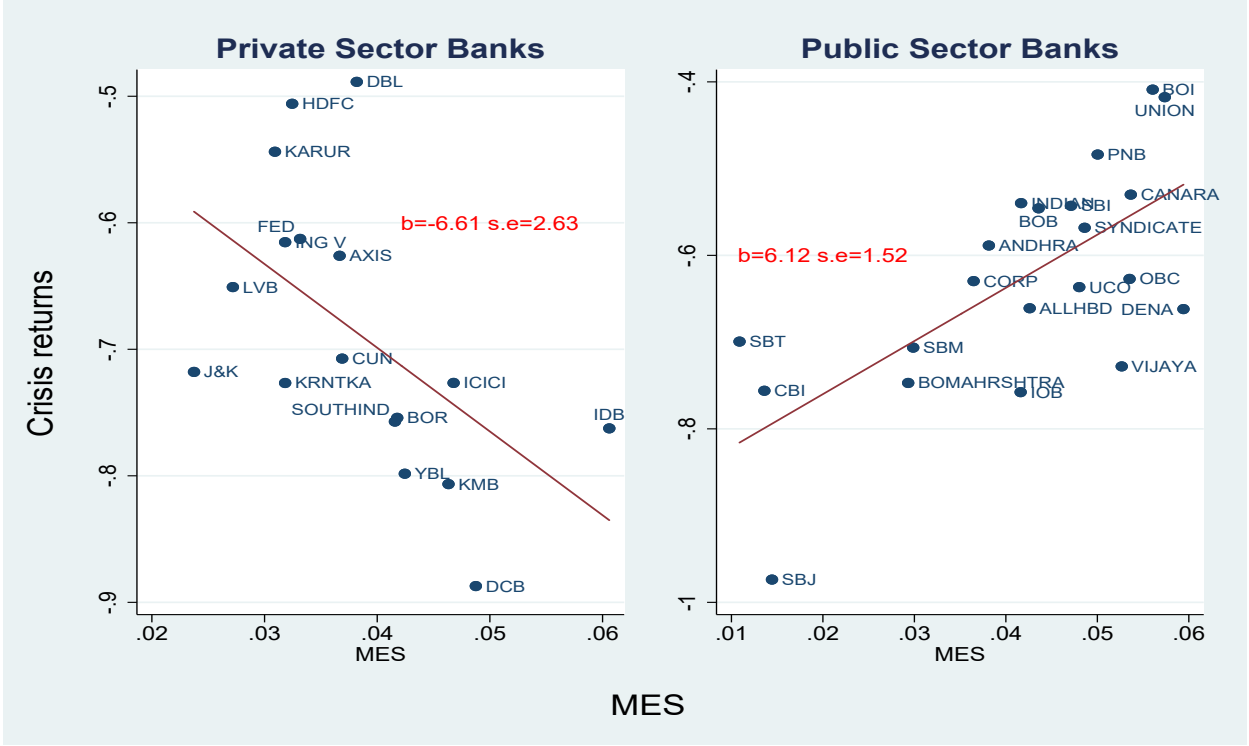


(a) **17th March 2008 – Bear Stearns** (b) **15th September 2008 – Lehman**

Figure 2: Stock Performance and Deposit Growth Versus *MES*

The figures above show the cumulative average returns (CAR) of the private and public sector banks against bank vulnerability. The market model is used to estimate the expected return wherein for each bank, its stock returns are regressed on market returns separately over the estimation window starting 250 days prior to the event window and ending 10 days before the event date. The cumulative abnormal returns (CAR) are computed by cumulating the abnormal returns across time over the event window. The event window is five days before and ten days after the event date. Market return is based on the S&P CNX NIFTY. The dashed vertical line is the date of the Bear Stearns collapse (17th March 2008) in Panel A and the date of the Lehman bankruptcy (15th September 2008) in Panel B. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. High *MES* refers to the top 7 banks within public (or private) sector banks. Remaining are classified as low *MES* banks.

Panel A: Crisis Returns vs. *MES*



Panel B: Deposit Growth vs. *MES*

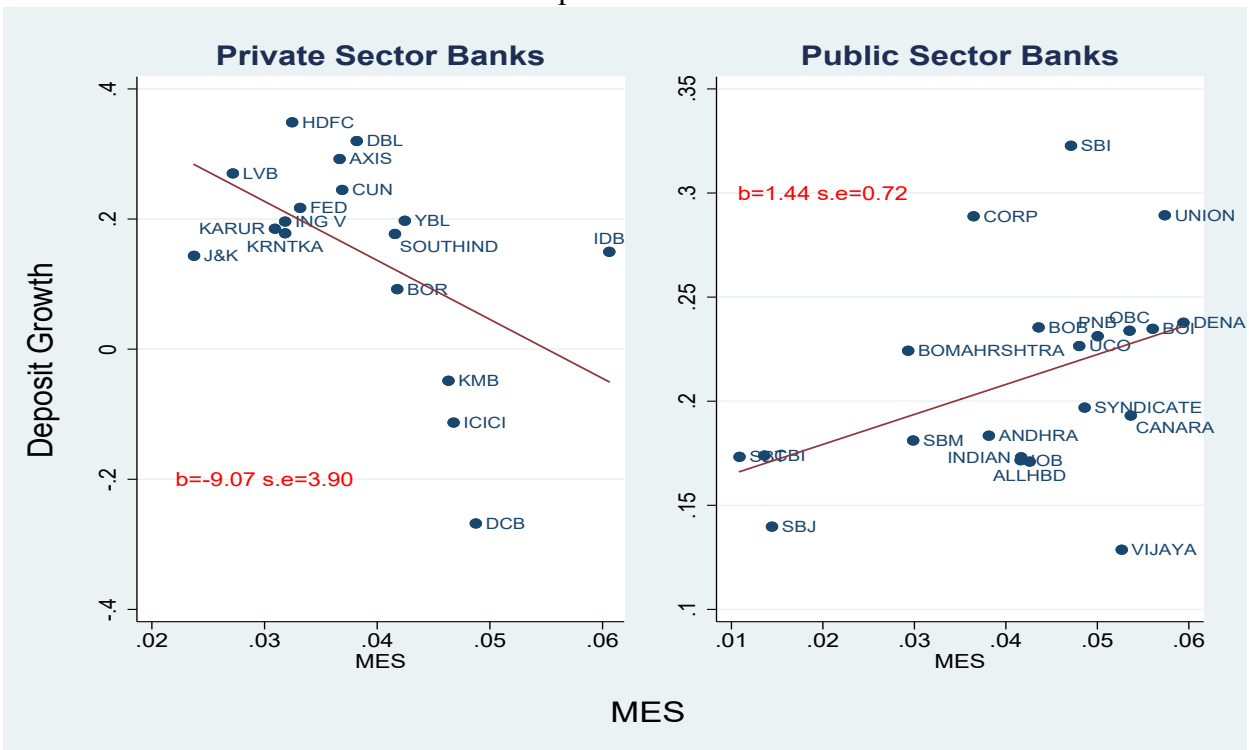


Figure 3: Stock Performance and Deposit Growth Versus *MES*

Panel A and Panel B plot crisis returns and deposit growth during the crisis respectively against *MES* for private and public sector banks. Crisis return is the stock return calculated from January 2008 to February 2009. Deposit growth is from March 2008 to March 2009. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th- percentile during the period 1st January, 2007 to 31st December, 2007. All 38 banks for which data is available are used in the analysis.

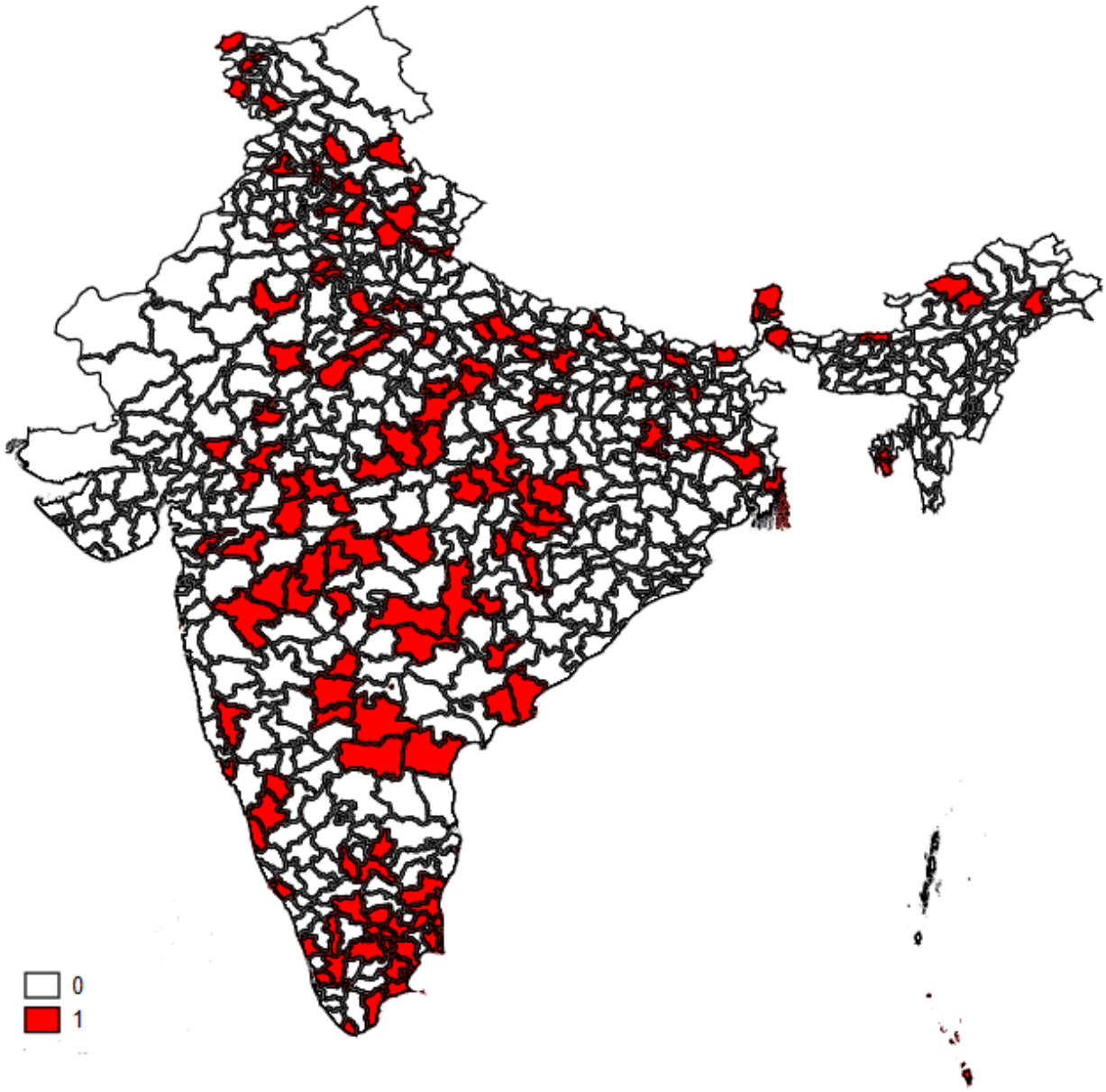


Figure 4: Map of public sector bank exposure variable

This figure shows the geographic variation of the public sector bank exposure variable used in our analysis. Our identification strategy uses the variable $\mathbb{1}_{PSB\,Branch\,Share}$ coded at the district level. The variable is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Districts where $\mathbb{1}_{PSB\,Branch\,Share}$ takes a value of 1 are shown in red.

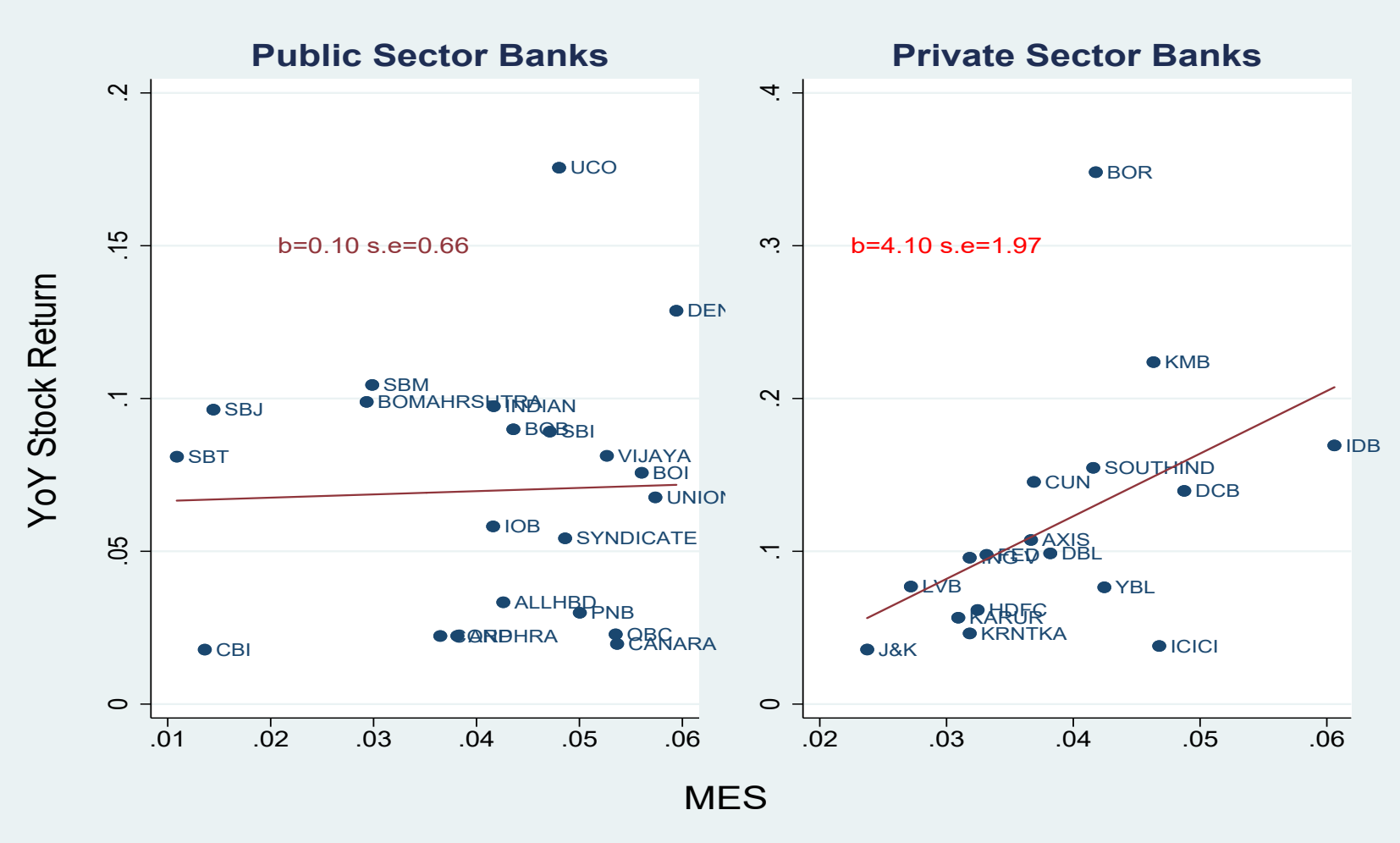


Figure 5: *MES* and stock performance in non-crisis periods

The graph above plots returns during the year preceding the crisis period against *MES* for private (right panel) and public sector banks (left panel). Stock returns are calculated from January 2007 to December 2007. *MES* is the marginal expected shortfall of a stock given that the market return is below its 5th- percentile during the period 1st January, 2007 to 31st December, 2007. The fitted lines are represented by red. All 38 banks for which data is available were used in the analysis.

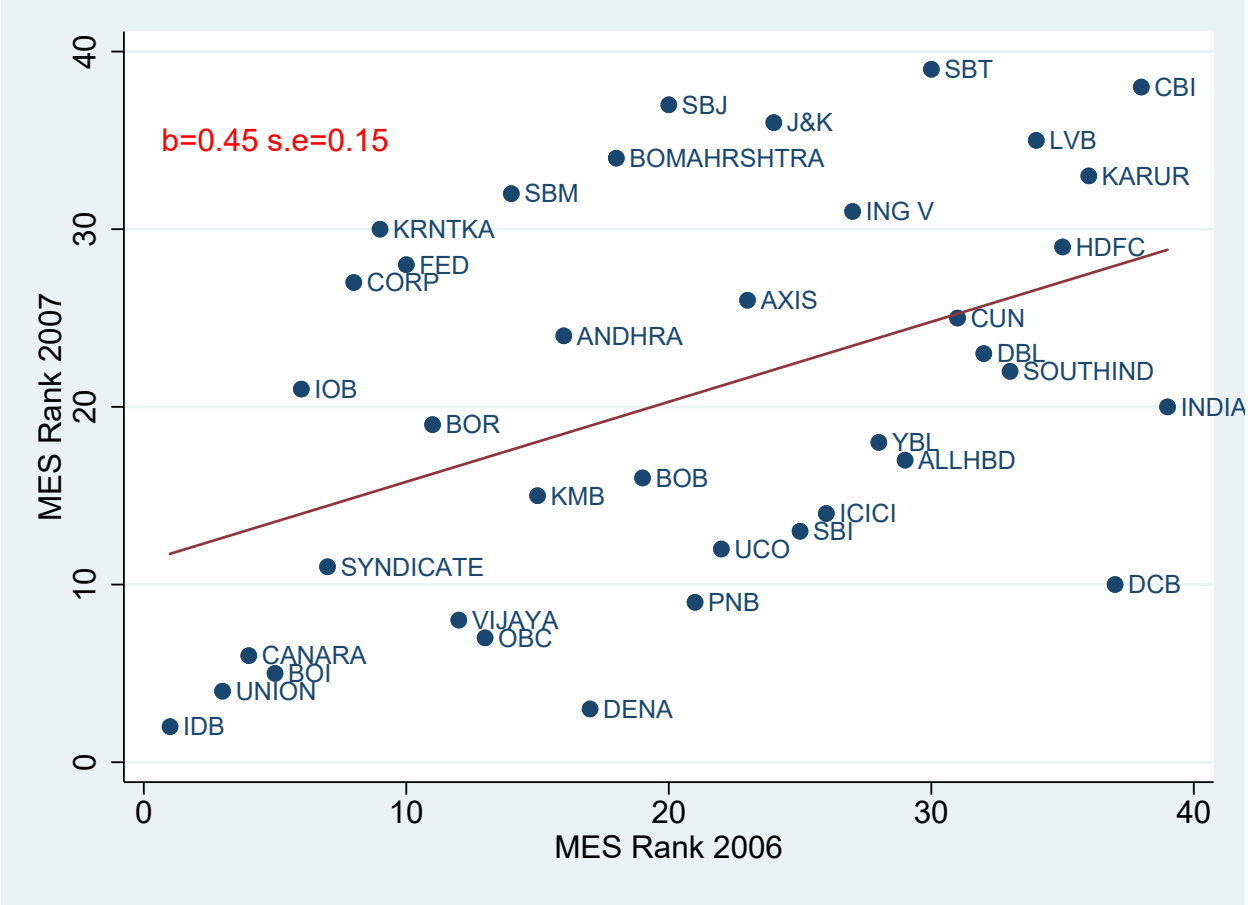


Figure 6: MES Rank for Jan '07–Dec '07 versus *MES* Rank for Jan '06–Dec '06

The graph above shows the scatter plot of the *MES* Rank computed during the period 1st January, 2007 to 31st December, 2007 versus the *MES* Rank computed during the period from 1st January, 2006 to 31st December, 2006. *MES* for a period is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the same period. Market return is based on the S&P CNX NIFTY. *MES Rank* ranks banks in descending order of *MES* values (assigns rank 1 to the bank with the largest *MES*). The 38 banks for which data was available for both periods were used in the analysis.

For Online Publication: Appendix

A. Model

This section presents a simple model to motivate our empirical work. We build a simple model to explain how government guarantees can distort behavior and outcomes for these protected banks. We then compare their outcomes and behavior with banks that do not enjoy such government guarantees. To maintain consistency with our empirical hypothesis in the context of India, we shall refer to the protected banks in the model as PSBs (PSBs) and the unprotected banks as private sector banks. In India state-owned banks or PSBs enjoy explicit government guarantees whereas private sector banks do not have these explicit government guarantees.

Consider the following simple model (see Figure A.1). Nature selects either of two states, the idiosyncratic state or the crisis state. The idiosyncratic states occurs with a probability $(1-p)$ and a crisis state occurs with a probability p. When the idiosyncratic state occurs either of two things can happen –either the bank fails with a probability λ^i in which case it gets a payoff of 0 or it survives with a probability $(1-\lambda^i)$ in which case it gets a payoff of c. c can be thought of as the cashflows of the bank or the franchise value of the bank. In case of an idiosyncratic shock and subsequent bank failure, there is no difference between a public sector or a private sector bank. Both types of banks get a value of zero in case of a failure. The assumption is that government guarantees do not kick in the idiosyncratic state and hence there is no difference between a public and private sector banks.

Now consider the case when there is an aggregate shock. A mass $(1-\mu)$ of banks have high MES and the remaining μ banks have low MES. Let this economy have a proportion of θ PSBs and $(1-\theta)$ private sector banks. If a system-wide shock hits the economy, then high MES banks will fail with a high probability whereas low MES banks will fail with a low probability. For simplicity, let us assume that low MES banks do not fail whereas high MES banks have some non-zero probability of failing . Let λ^q be the probability that a high MES bank fails when there is an aggregate shock and $(1-\lambda^q)$ be the probability that it survives. Now if a high MES bank survives then it gets the full amount c of cashflows. If it fails, however, private and public sector banks get different amounts. The crucial assumption here is that PSBs are government guaranteed.

Let us first consider the simple case when no banks fail. Note, our simplifying assumption says that low MES banks do not fail. We need to only consider the high MES banks. With probability $(1-\lambda^q)$ no high MES bank fails. In this case, all banks receive a payoff of c similar to the idiosyncratic case.

Now consider the case when some high MES banks fail which happens with a probability (λ^q). However, the presence of government guarantees for PSBs implies that private sector banks are more adversely affected compared to PSBs. A failing private sector bank which has no government guarantees receives a lower cashflow of δc, where $\delta < 1$. One can also think of c as the demand for bank services. When a high MES private sector bank fails (which happens with probability λ^q), then there is a $(1-\delta)c$ of gap in demand for bank services. This demand in bank services is filled in by the surviving banks, that is, between the public sector (both high and low MES) banks and the remaining low MES private sector banks. We now introduce another parameter ϕ which controls the distribution of this excess demand between high MES PSBs and low MES banks (both PSBs and private sector banks).

Given the above setup we can calculate the franchise values for the banks in each state. The franchise value for a High MES Public Sector Bank (PSB) is given by $c+(1-\mu)(1-\delta)(1-\phi)c$. The value for a High MES Private bank that fails is δc and High MES Private bank that survives is c. The franchise value for a Low MES bank is given by $c+(1-\mu)(1-\delta)\phi c$. This is shown in Figure A.1.

We now look at some testable implications from this simple setup. Specifically, we want to relate how the ex ante bank franchise value changes as the probability of an aggregate crisis increases. Additionally, we want to relate franchise value of banks to their vulnerability as measured by MES.

Let V^{Pvt} and V^{PSB} represent the franchise value of the private sector banks and PSBs respectively. Let ΔV^{PSB} represent the difference in franchise value between high MES PSBs and low MES PSBs.

Using the franchise values calculated above

$$\begin{aligned}\Delta V^{PSB} &= p\theta[c+c(1-\mu)(1-\delta)(1-\phi)-c-(1-\mu)(1-\delta)\phi c] \\ &= p\theta[c(1-\mu)(1-\delta)-2c(1-\mu)(1-\delta)\phi] \\ &= p\theta(1-\mu)(1-\delta)(1-2\phi)c\end{aligned} \tag{8}$$

Note, $\Delta V^{PSB} > 0$ if and only if $(1-2\phi) > 0$, that is, $\phi < 1/2$. This tells us that only for low values of ϕ, PSBs with high exposure to aggregate risk (high MES) will have franchise values lower than PSBs with lower exposure to aggregate risk (low MES).

Analogously, let us define ΔV^{Pvt} as the difference in franchise value between high and low MES private sector banks.

$$\begin{aligned}\Delta V^{Pvt} &= p(1-\theta)[\delta c\lambda^q+(1-\lambda^q)c-c-(1-\mu)(1-\delta)\phi c] \\ &= p(1-\theta)[\delta c\lambda^q-c\lambda^q-(1-\mu)(1-\delta)\phi c] \\ &= -p(1-\theta)(1-\delta)[\lambda^q+(1-\mu)\phi]\end{aligned} \tag{9}$$

Differentiating the above with respect to p, $d\Delta V^{Pvt}/dp < 0$ for all values of ϕ.

This simple model helps us motivate our empirical hypothesis in Section 4. $(1-\phi)$ parameterizes the amount that high MES PSBs are able to attract. We need ϕ to be less than 0.5 for franchise value of high MES PSBs to be higher than low MES PSBs. That is, high MES PSBs need to attract the excess supply of deposits created by a failed high MES private sector bank. This can occur if say the PSB is too big to fail– such as in the case of SBI and its subsidiaries or if ex-ante they gamble and manage to attract deposits their way, say, by increasing deposit rates as in the case of our results.

This yields the following hypotheses. The first hypothesis relates to how ΔV^{Pvt} and ΔV^{PSB} changes as the probability of aggregate crisis increases.

Hypothesis 1. *More vulnerable PSBs, i.e., banks with greater aggregate risk exposure, had higher*

returns during the crisis compared to less vulnerable PSBs. Analogously, more vulnerable private sector banks had lower returns compared to less vulnerable private sector banks.

However our simple model showed that the result for PSBs is true only if $\phi < 1/2$. That is high *MES* PSBs were able to attract deposits their way, say, by increasing deposit rates as in the case of our results. On the other hand, for private sector banks we don't need $\phi < 1/2$.

This leads to the second hypothesis.

Hypothesis 2. *More vulnerable PSBs have higher deposit growth compared to less vulnerable PSBs. In contrast, more vulnerable private sector banks have lower deposit growth compared to less vulnerable private sector banks.*

One way in which PSBs can ensure $\phi < 1/2$ is by increasing deposit rates.

Hypothesis 3. *Greater deposit growth for PSBs with greater vulnerability to a crisis is due to them increasing their deposit rates.*

Note, we are ambivalent about whether deposits rates increase or decrease for private sector banks. Since, private sector banks are perceived to be more vulnerable, they may not not be able to retain depositors by increasing their deposit rates.

Figure A.1: Bank Payoffs in Idiosyncratic and Crisis States of Nature

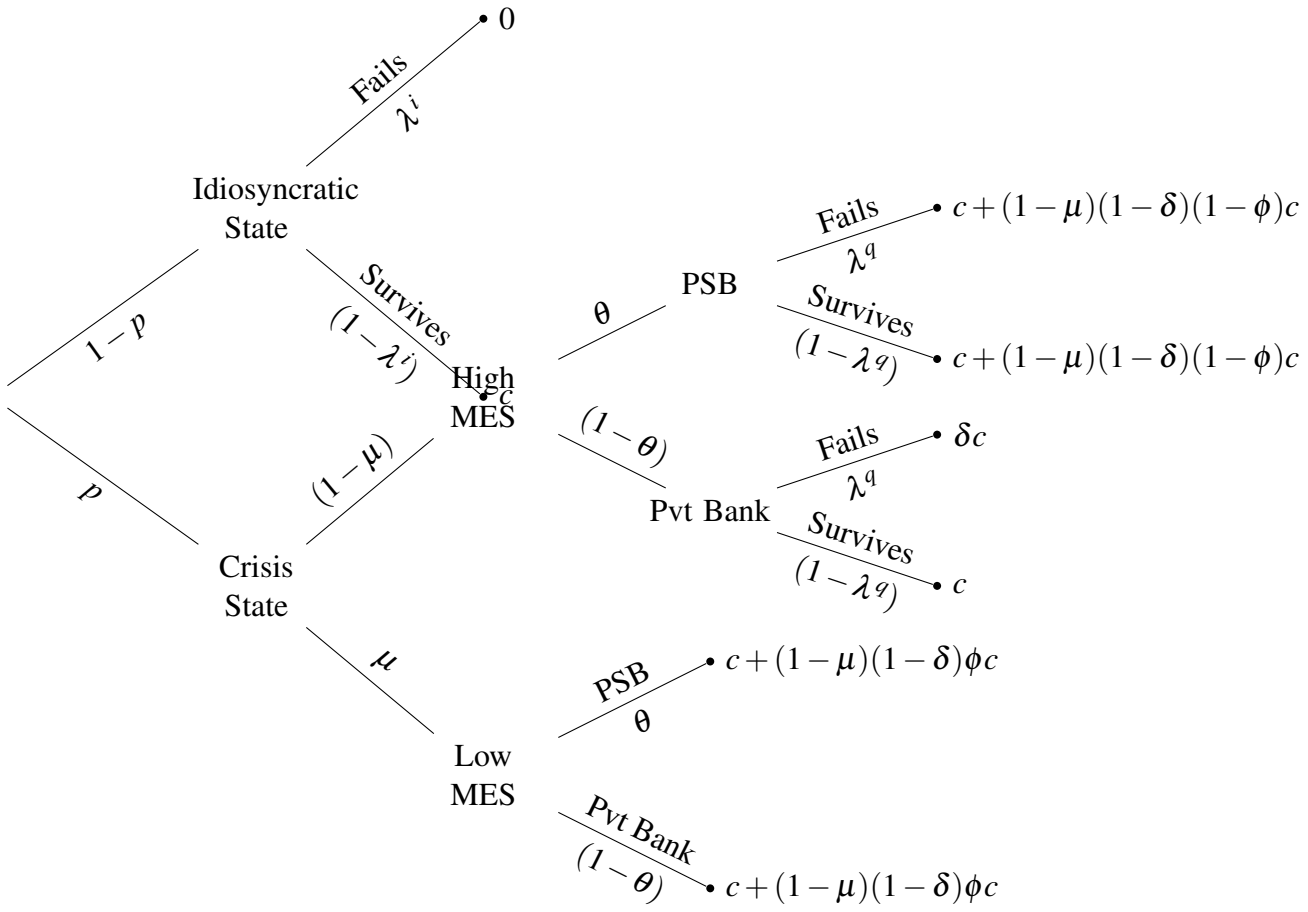


Table A.1: Bank Data during 2007–2009

Panel A: Public Sector Banks

Bank Name	*MES*	Pre-crisis Returns	Crisis Returns	Deposit Growth	Credit Growth
Allahabad Bank	0.04	0.03	-0.66	0.17	0.17
Andhra Bank	0.04	0.02	-0.59	0.18	0.25
Bank of Baroda	0.04	0.09	-0.55	0.24	0.29
Bank of India	0.06	0.08	-0.41	0.23	0.23
Bank of Maharashtra	0.03	0.10	-0.75	0.22	0.16
Canara Bank	0.05	0.02	-0.53	0.19	0.25
Central Bank of India	0.01	0.02	-0.76	0.17	0.16
Corporation Bank	0.04	0.02	-0.63	0.29	0.21
Dena Bank	0.06	0.13	-0.66	0.24	0.23
Indian Bank	0.04	0.10	-0.54	0.17	0.25
Indian Overseas Bank	0.04	0.06	-0.76	0.17	0.21
Oriental Bank of Commerce	0.05	0.02	-0.63	0.23	0.23
Punjab National Bank	0.05	0.03	-0.48	0.23	0.26
State Bank of Bikaner and Jaipur	0.01	0.10	-0.97	0.14	0.17
State Bank of India	0.05	0.09	-0.54	0.32	0.26
State Bank of Mysore	0.03	0.10	-0.71	0.18	0.20
State Bank of Travancore	0.01	0.08	-0.70	0.17	0.15
Syndicate Bank	0.05	0.05	-0.57	0.20	0.24
UCO Bank	0.05	0.18	-0.64	0.23	0.22
Union Bank of India	0.06	0.07	-0.42	0.29	0.26
Vijaya Bank	0.05	0.08	-0.73	0.13	0.11

Panel B: Private Sector Banks

Bank Name	*MES*	Pre-crisis Returns	Crisis Returns	Deposit Growth	Credit Growth
Axis Bank	0.04	0.11	-0.63	0.29	0.31
Bank of Rajasthan	0.04	0.35	-0.75	0.09	0.05
City Union Bank	0.04	0.15	-0.71	0.24	0.22
Development Credit Bank	0.05	0.14	-0.89	-0.27	-0.22
Dhanalakshmi Bank	0.04	0.10	-0.49	0.32	0.42
Federal Bank	0.03	0.10	-0.61	0.22	0.17
HDFC Bank	0.03	0.06	-0.51	0.35	0.44
ICICI Bank	0.05	0.04	-0.73	-0.11	-0.03
IndusInd Bank	0.06	0.17	-0.76	0.15	0.21
ING Vysya Bank	0.03	0.10	-0.62	0.20	0.13
Jammu & Kashmir Bank	0.02	0.04	-0.72	0.14	0.10
Karnataka Bank	0.03	0.05	-0.73	0.18	0.09
Karur Vysya Bank	0.03	0.06	-0.54	0.19	0.10
Kotak Mahindra Bank	0.05	0.22	-0.81	-0.05	0.07
Lakshmi Vilas Bank	0.03	0.08	-0.65	0.27	0.31
South Indian Bank	0.04	0.15	-0.76	0.18	0.13
Yes Bank	0.04	0.08	-0.80	0.20	0.27

This table contains the list of 38 Indian banks used in our analysis. Panel A contains the public sector banks and panel B contains the private sector banks. *MES*, *Pre-Crisis Returns*, *Crisis Returns*, *Deposit Growth* and *Credit Growth* are shown. *MES* (shown in percentage) is the marginal expected shortfall of a stock given that the market return is below its 5^{th}-percentile during the period 1st January, 2007 to 31^{st} December, 2007. Market return is based on the S&P CNX NIFTY for the pre-crisis period from January 2007 to December 2007. $Pre-crisis\ return$ is the stock return for the period January 2007 to December 2007. *Crisis return* is the stock return for the period January 2008 to February 2009. *Deposit growth* for the crisis period is calculated for the period from 31^{st} March, 2008 to 31^{st} March, 2009. *Credit growth* for the crisis period is calculated for the period from 31^{st} March, 2008 to 31^{st} March, 2009. The 38 banks for which both *MES* data and RBI deposit growth estimates are available were used in this analysis.

Table A.2: Alternate measures of risk

	(1)	(2)	(3)	(4)	(5)
PSB Branch Share * Volatility	-7.736				
	(21.58)				
PSB * PSB Branch Share * Volatility	20.10				
	(23.71)				
PSB Branch Share * ES		-36.99			
		(199.9)			
PSB * PSB Branch Share * ES		189.3			
		(223.5)			
PSB Branch Share * Beta			-15.10*		-8.625
			(8.187)		(19.57)
PSB * PSB Branch Share * Beta			8.813		4.315
			(8.948)		(20.24)
PSB Branch Share * Global Beta				-13.23**	-6.330
				(6.497)	(15.53)
PSB * PSB Branch Share * Global Beta				6.848	3.977
				(7.323)	(16.04)
No. of Obs.	40362	38254	40362	40362	40362
R squared	0.0753	0.0762	0.0757	0.0757	0.0757

This table shows the results of deposit growth against alternative measures of risk. Deposit growth is for the period from 31st March, 2008 to 31st March, 2009. Deposits data is from RBI. Annualized daily volatility of returns based on the S&P CNX NIFTY index is for the period January 2007 to December 2007. Expected shortfall (ES) is the expected return of the bank when the bank's return is below its 5th percentile, during the period 1st January 2007 to 31st December 2007. Beta and global beta is based on the S&P CNX NIFTY index and MSCI World Index returns respectively. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. All columns include bank and district fixed effects. Standard errors are clustered at the district level.

Table A.3: Modified MES measures and robustness to leverage and size

	(1)	(2)	(3)	(4)	(5)
PSB Branch Share * Modified MES	-3.734*				
	(2.006)				
PSB * PSB Branch Share * Modified MES	4.958**				
	(1.978)				
PSB Branch Share * W-MES		-3.751*			
		(2.069)			
PSB * PSB Branch Share * W-MES		3.341			
		(2.102)			
PSB Branch Share * Lvg.			0.000317		
			(0.187)		
PSB * PSB Branch Share * Lvg.			0.0709		
			(0.204)		
PSB Branch Share * Log Assets				0.0516	
				(1.482)	
PSB * PSB Branch Share * Log Assets				-4.543**	
				(1.795)	
PSB Branch Share * Liquidity					9.293
					(71.29)
PSB * PSB Branch Share * Liquidity					104.7
					(75.70)
No. of Obs.	38254	38254	40362	40362	40362
R squared	0.0764	0.0763	0.0753	0.0769	0.0761

This table shows the results of deposit growth against measures of systemic risk, leverage, asset size and liquidity. Deposit growth is for the period from 31st March, 2008 to 31st March, 2009 for each category. Deposits data is from RBI. MES is the marginal expected shortfall of a stock given that the market return is below its 5th - percentile during the period 1st January, 2007 to 31st December, 2007. Modified MES is similar to MES except market return is calculated using all banks in the economy excluding the bank for which MES is being calculated. $W-MES$ is a weighted MES which uses exponentially declining weights (λ=0.94) on past observations to estimate the average equity returns on the 5 percent worst days of the market. Book value of assets is as of 31st March, 2008. Leverage (as of 31st March, 2008) is ratio of the quasi- market value of assets (book value of assets - book value of equity + market value of equity) to the market equity. Liquidity is the sum of cash in hand, balances with RBI, money at call and short notice, government securities and deposits to the total liabilities as of 31st March, 2008. $\mathbb{1}_{PSB\,Branch\,Share}$ is at the district level and is one if the share of deposits of public sector banks within a district is in the top two terciles in 2006. Only districts where private sector bank deposit share is greater than one percent are retained. $\mathbb{1}_{PSB}$ is 1 for public sector banks and 0 for private sector banks. All columns include bank and district fixed effects. Standard errors are clustered at the district level.

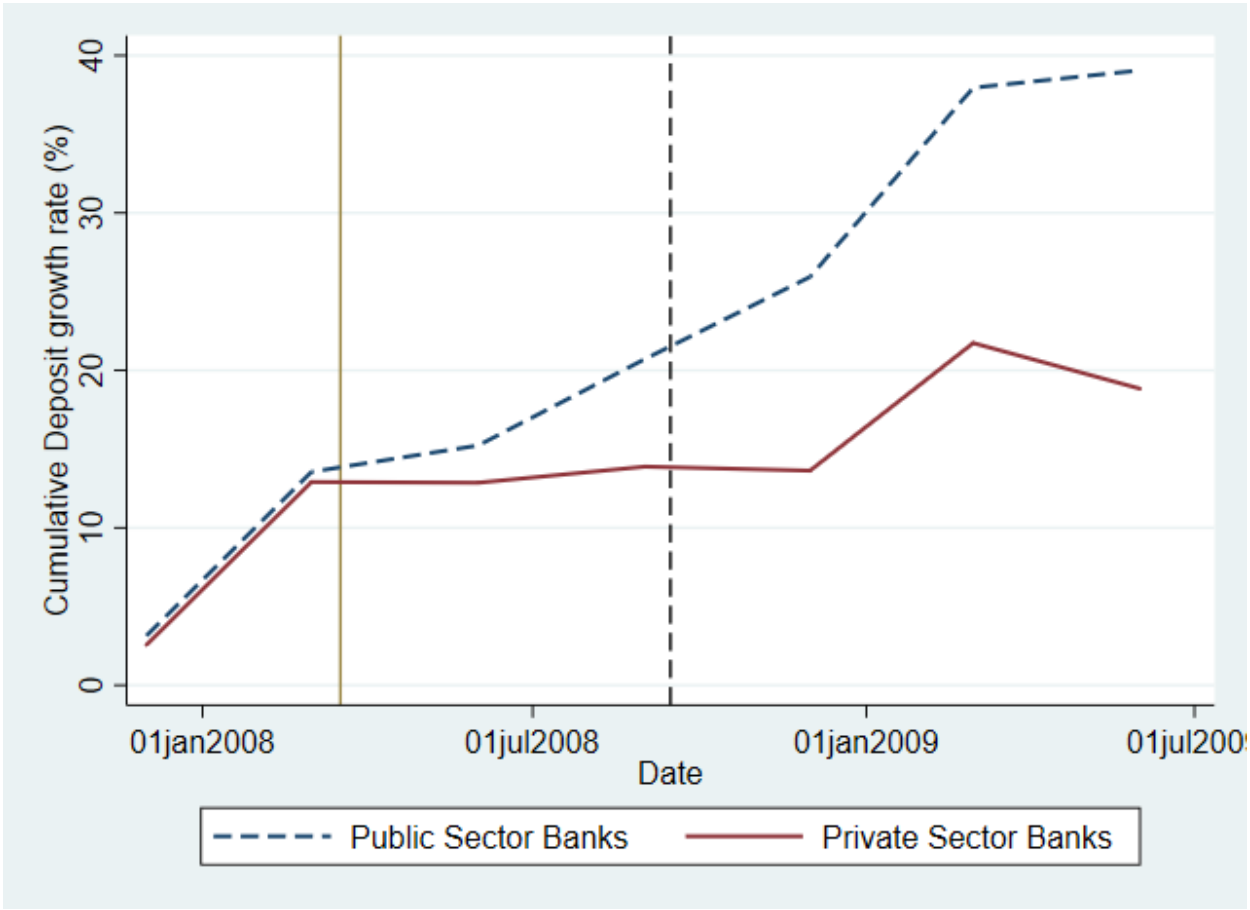


Figure A.2: **Deposit growth QoQ**

This figure shows the cumulative deposit growth of deposits separately for public (dashed blue line) and private sector banks (solid red line). The vertical solid black line denotes the date of the Bear Stearns collapse (17th March 2008) and the vertical dashed grey line denotes the date of the Lehman bankruptcy (15th September 2008).